Long-Term Trends in the Contributions of Salmon from Different Geographic Areas to the Commercial Fisheries of the North Pacific

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September 1985

LONG-TERM TRENDS IN THE CONTRIBUTIONS OF SALMON FROM DIFFERENT GEOGRAPHIC AREAS TO THE COMMERCIAL FISHERIES[1] OF THE NORTH PACIFIC

BY

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ABSTRACT

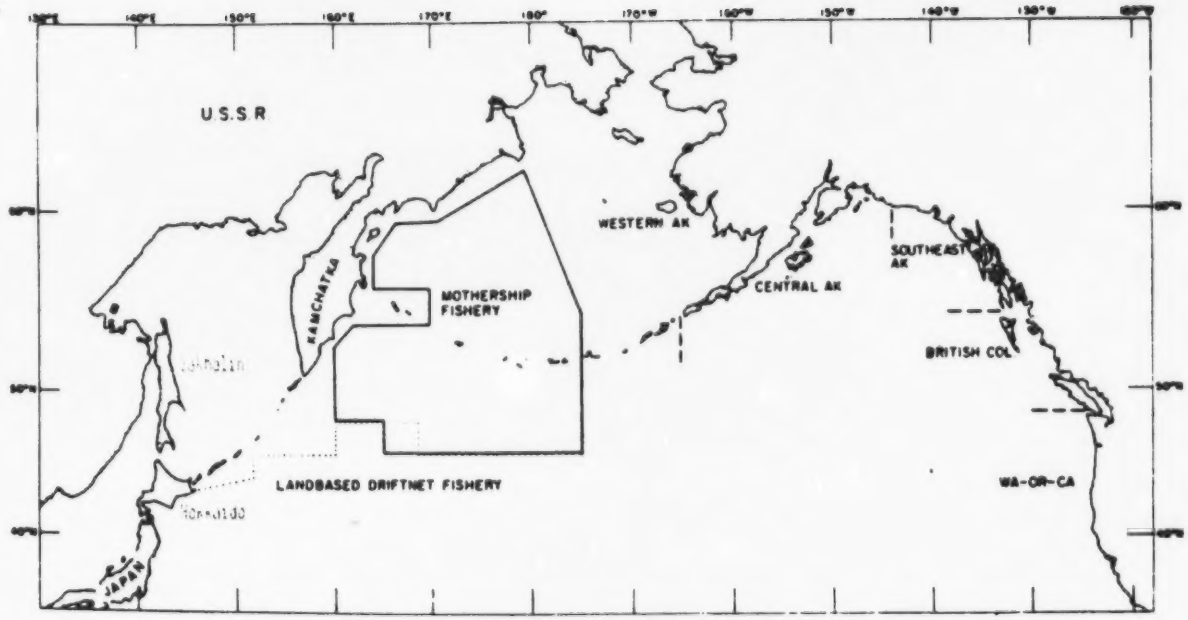
Shepard, M.P., C.D. Shepard and A.W. Argue. 1985. Long term trends in the contributions of salmon from different geographical areas to the commercial fisheries of the north pacific. Can. Tech. Rep. Fish. Aquat. Sci. 1376; 52 p.

The report collates available information on annual catches around the Pacific Rim. A series of graphs and tables are provided that depict trends in catches of salmon by individual countries and estimate contribution of salmon by rivers of each geographical area. In addition, the report contains speculation on future trends in production and a brief note on production of Atlantic salmon.

RESUME

Shephard, M.P., C.D. Shepard and A.W. Argue. 1985. Long term trends in the contributions of salmon from different geographical areas to the commercial fisheries of the north pacific. Can. Tech. Rep. Fish. Aquat. Sci. 1376: 52 p.

Le present rapport rassemble l'information disponible sur les prises annuelles dans les pays du littoral du Pacifique. Il contient une serie de graphiques et de tableaux qui decrivent les tendances des cours d'eau de chaque secteur geographique. On trove egalement dans ce rapport des hypotheses sur les tendances futures de la production et une breve observation sur la production du saumon de l'Atlantique.



Fishing areas for Pacific salmon (after Fredin, 1980).

1.0 INTRODUCTION

For more than 100 years, Pacific salmon have provided the basis for important commercial fisheries by Japan, the USSR, the United States and Canada. The present report attempts to collate available information on annual catches around the Pacific Rim in order to trace trends in the contribution of stocks from different regions to the fisheries. Since Pacific salmon undertake extensive migrations that result in fishermen in waters of one country harvesting salmon bound for rivers of another, the work has involved assembling not only information on catches but also on the origins of salmon included in such catches. In many cases, particularly for the early years of the fisheries, information on abundance of harvests is inaccurate, or incomplete, or both. Information on the origins of salmom in different fisheries is also often of dubious accuracy. Despite these shortcomings, it was felt worthwhile to make a "first cut" appraisal of long-term trends in production as background for assessing the potential productivity of the salmon resource. That is what the present brief report sets out to do.

Since this is a "first cut" document, there is no question that more thorough appraisals of catch data and of information on migration routes would greatly improve the accuracy and comprehensiveness of the information presented.

This report focuses on a series of graphs and tables depicting trends in catches of salmon by individual countries and in estimated contributions ("production") of salmon by the rivers of each geographical area (Japan, areas presently under USSR jurisdiction, Alaska, Canada (including the rivers tributary to coastal British Columbia and Canadian sections of rivers which flow to the sea through United States territory), and Washington/ Oregon/Idaho/California. The voluminous data on which the graphs are based are contained in background reports prepared by Shepard et al. (1985) and Argue and Shepard (1984). The reader is referred to these papers for explanations of methodology and discussions on the reliability and completeness of the information utilized.

In its final sections, the report contains speculation on future trends in production, particularly with respect to stocks originating in Asian rivers. A brief note on production of Atlantic salmon is included for purposes of comparison.

The present report was prepared under a contract commissioned by the Department of Fisheries and Oceans. The authors would like to express their appreciation to Mr. C.C. Graham of the Department, whose encouragement and support throughout the project greatly facilitated their task.

2.0 CATCHES BY COUNTRY

Commercial fisheries for Pacific salmon began on a large scale with the introduction of canning in the 1860s. By the first decades of the twentieth century, catches of Pacific salmon had reached levels not very different from those of recent times (Figure 1). For most species of Pacific salmon, peak catches occurred before 1945 (Figure 2-6). In general, the 1950s and 1960s represented a period of decline, whereas for some species at least, there has been a degree of recovery during the 1970s and the early 1980s.

2.1 Sockeye

As shown in Figure 2, the most important fisheries for sockeye have consistently taken place in Alaska (mainly Western Alaska, the location of the productive Bristol Bay systems). United States sockeye catches in Alaska crested between 1910 and 1920, fluctuated around 50,000 tonnes in the 1930s and 1940s and, with some wide-ranging fluctuations, dropped to the lowest levels of the twentieth century during the 1970s. Since then, the catches have rebounded and, during the 1980s, new records have been set. In the late 1800s and early 1900s, fisheries in Canada and Washington State (primarily fishing sockeye bound for the Fraser River) rivaled the Alaskan fisheries, but since then, with the exception of the occasional year, catches have been much less than half the Alaskan totals. Prior to World War II, Japan, and to a lesser extent the USSR, established substantial fisheries on runs bound primarily for the rivers of Kamchatka and the northern Sea of Okhotsk. After the war, the Japanese, prohibited from fishing close to the USSR coast, established mothership and land-based fisheries operating on the high seas of the central North Pacific and Bering Seas, harvesting a mixture of sockeye stocks bound for the rivers of the USSR and of Western Alaska. During 1955-1964, the Japanese catch rivaled that of Alaska, which at that time was recording catches substantially below those of the pre-war period. With the advent of the Japanese high seas fishery, USSR coastal catches of sockeye declined and have shown little sign of recovery since. With constant diplomatic pressure from the United States and the USSR and with the establishment of 200-mile fishing zones by both coastal States in the late 1970s, Japanese high seas fishing activities have been increasingly restricted in recent years. As a consequence, the Japanese sockeye catch has fallen to very low levels.

2.2 Pinks

Pink salmon are the most abundant of the Pacific salmons. Until World War II, Japanese catches (mainly of pinks bound for the USSR), dominated the world-wide pink fishery (Figure 3). According to available records, beginning in the early 1930s, the USSR fishery also took very large quantities of pinks. During World War II and in the immediate post-war period,

in the odd-numbered years, the USSR fishery virtually replaced that of the Japanese in terms of total catch. Japan, however, developed its high seas fisheries in the mid-1950s and, although unable to achieve catch levels comparable to those of the pre-war period, nevertheless resumed its position as the principal harvester of Asian pink salmon. Conversely, the USSR coastal catches declined. Restriction of the Japanese fishery in recent years has led to a marked drop in the latter's high seas harvest. In contrast to sockeye (where restrictions on the Japanese fishery were accompanied by only a modest absolute increase in USSR coastal catches), recent reductions in the Japanese fisheries for pink salmon have been accompanied by marked increases in the USSR coastal catch. The combined catches of the USSR and Japan, however, continue to be much smaller than they were during the heyday of the fishery before World War II.

On the North American side, Alaskan fisheries for pinks developed rapidly in the 1920s and 1930s, peaking in the late 1930s. After a decline during the 1950s and 1960s, catches have increased somewhat in recent years to the extent that pink catches in North American waters now rival those of Asia. Catches by Canadian and Washington State fishermen (mainly of pinks bound for Canadian rivers) have been consistently lower than those in Alaska. Production in the odd-numbered years has been relatively constant but in the even-numbered years, after reaching a peak in the early 1960s, catches have recently tended to decline.

2.3 Chums

Japan has always been the dominant harvester of chum salmon in the North Pacific (Figure 4). Its pre-World War II fisheries, harvesting mainly chums bound for USSR rivers around Kamchatka, the Sea of Okhotsk and the Japan Sea, peaked in the late 1930s. At about the same time, the USSR developed substantial inshore fisheries which took the bulk of the Asian chum catch during World War II and in the immediate post-war period. As for sockeye and pinks, establishment of a high seas fishery in the mid-1950s permitted Japan to regain its position as the principal harvester of Asian chums; USSR chum catches dropped correspondingly. There has been a moderate increase in USSR chum catches since establishment of the USSR and United States 200-mile zones in the late 1970s. In spite of limitation of its high seas fishery, Japanese catches of chums have increased more or less continuously since the late 1960s. As will be outlined in more detail later in this report, the increase is due mainly to the phenomenal production of chums in Japanese hatcheries. Most of the hatchery production is now harvested in Japanese coastal waters. Catches of chum salmon in Alaska and in the British Columbia-Washington State fisheries have always been less than those on the Asian side. Within North America, catches in Alaska and in waters to the south (Canada and Washington/Oregon/California), were formerly about evenly balanced. In recent years however, with the odd exception,

Alaskan catches have exceeded those in the more southerly areas.

2.4 Coho

Coho are predominantly a North American fish. Catches on the North American side have been spread rather evenly along the coast, with Canada, Alaska and Washington/Oregon/California each taking more or less similar quantities (Figure 5). In very recent years, however, Alaskan catches have tended to increase, whereas those of Canada and the Northwest States have shown signs of decrease. Catches by Japan and the USSR have also tended to decline.

2.5 Chinook

Chinook also are primarily a North American fish. Chinook of the Columbia River provided the basis for the establishment of the commercial salmon fishing industry in the late 1860s. Production there in the 1880s provided catches in most years greater than those that have been achieved on the river since. As with coho, current catches of chinook are spread rather evenly along the North American coast, with Alaska, Canada and Washington/Oregon/California taking similar quantities (Figure 6). Also as with coho, catches in Alaska have recently tended to rise while catches in Canada and in Washington/Oregon/California have begun to fall. Catches by Japan and the USSR have always tended to be small.

3.0 PRODUCTION FROM THE RIVERS OF EACH COUNTRY

As outlined in the introduction to this report, because salmon migrate extensively on the high seas and through coastal waters, many that are bound for the rivers of one country are intercepted by fishermen of another. This is particularly true in the case of the Japanese fisheries. The Japanese industry developed mainly through exploitation of salmon bound for rivers of the USSR and, following World War II, of salmon bound for Alaskan rivers as well. Canadian and United States fishermen exploit substantial numbers of salmon bound for rivers of the other country in the coastal waters of Southeast Alaska, British Columbia and Washington State. The present study has attempted to estimate the contributions of the rivers of each country to the fisheries, and by summing such contributions to estimate the net production by geographic area. The following brief review summarizes information on the quantities of salmon produced in each geographic area. In the present report, the term "production" is used to describe the total contribution of the rivers of each area to the global commercial harvest of each species; as used here, the term does not refer to the total biomass produced nor to the total adult return (i.e., catch plus escapement). Nor does the report take account of sizable catches of salmon in recreational and subsistence fisheries (particularly on the North American side). Data for such fisheries is in most cases only approximate and not available for earlier years. The

authors are attempting to develop an array of information on the recreational and subsistence fisheries which would permit inclusion of such data in an analysis of overall production. In any event, such information would cover only the last few decades and would be of importance for only two species and only for North America.

3.1 Sockeye

The overwhelming preponderance of sockeye originating in Alaska is emphasized by segregation of catches by country of origin (Figure 7). Although Alaskan fisheries in Southeast Alaska have always intercepted modest numbers of sockeye bound for Canadian rivers (both in rivers tributary to the coast of British Columbia and in Canadian sections of transboundary rivers which drain to the sea through the United States), since 1955, these numbers have been more than offset by Japanese interceptions in the high seas fishery in the central North Pacific and the Bering Sea. Production from the USSR is similarly much greater than is reflected by catches by USSR fishermen alone and, because of interceptions in Washington State, the importance of Canadian rivers is not fully reflected by catches of Canadian fishermen. As shown in Table 1, recent (1973-1982) levels of production of sockeye in the USSR are less than one sixth of those that occurred in the peak decade of production (1928-1937). Alaskan runs have been relatively stronger, with the 1973-1982 harvest being about 75.7% of past peak levels (1911-1920). However, the decade by decade comparison presented in the Table does not tell the whole story for the Alaskan sockeye stocks; the runs have been increasing almost continuously since 1974 and production in 1981 was the highest on record. Recent production from Canadian rivers has been slightly under half that of the highest recorded levels (during 1903-1912).

3.2 Pinks

Figure 8 provides a similar treatment for pink salmon. The analysis shows the overwhelming predominance of USSR pinks, especially prior to World War II (when USSR-bound fish provided about two-thirds of the total global harvest of pinks - see Table 1). In recent years, production of pinks from USSR rivers has only been around half of historic peak levels. Alaska, the next biggest pink salmon area (currently providing between 27 and 44% of the global catch in the odd and even-numbered years) is providing salmon at about half (47%) of historic peak levels in the odd-numbered years and at about 57% of former peak levels in the even-numbered years. Canada produces only about 8-14% of the world pink catch; current levels are about two-thirds of historic highs. Japan and the Northwest United States produce only minor numbers of pink salmon.

3.3 Chums

Recent trends in chum salmon production are dominated by the astounding increase in production from Japan (Figure 9). Twenty years ago, production from Japanese rivers was only about 8% of world production. This has now risen to over half the world production, almost entirely as the result of application of successful hatchery techniques. Production from Canadian rivers, which was never great, remains at a low level (only about 10% of the global total) while production in the Northwest United States is even smaller (2%). On an historic basis, production from the USSR was the greatest of any area (providing almost two thirds of the world catch), but there has been a dramatic decline in chum production there since the Japanese high seas fishery began in the mid-1950s. As yet, despite a decline in the amount of high seas fishing by Japan, there is no evidence of substantial recovery. USSR rivers have recently provided less than a quarter of the world total. Production in Alaska has increased recently to levels higher than those prevailing during the past 40 years.

3.4 Coho

The peak of coho production from the rivers of the Northwest United States occurred relatively recently (from 1965 to 1974 - Figure 10) and, although showing a very recent decline (not reflected in the decade by decade figures), the runs are still producing at relatively high levels (three-quarters of the historic high). Canadian production during 1973-1982 was also close to the historic high. Alaskan production during the most recent decade under consideration has been very close to the highs of 1940-1949 and continues to show signs of further increase; catches in 1982 were the highest on record. North America currently provides over three-quarters of the world coho catch. Recent production from the USSR is about 71% of its historic high (the decade of 1955-1964)

3.5 Chinook

The rivers of Canada and Washington/Oregon/California currently provide almost 80% of the world's chinook catch (Figure 11 and Table 1). As in the case of coho, there has been a pronounced decline in chinook production in very recent years. A high proportion (47%) of the total global production of chinook orginates in Northwest State rivers. Canadian rivers have provided between a quarter and one-third of the total production. On an historic basis, production in the USSR and Alaska have each been in the order of 10 to 15% of the global total. As with other species, Alaska catches have tended to increase in recent years.

4.0 POSSIBLE FUTURE TRENDS

Forecasting the future of the Pacific salmon resources and their exploitation is an exercise filled with many pitfalls and uncertainties. What happens to the stocks and their utilization is very much dependent on trends in world markets for fish; on national fisheries management policies; and, in the cases where production has become dependent on artificial propagation, on the extent of investment in enhancement activities. It is almost impossible to predict the future pattern of such non-biological factors, which in many cases have a greater influence on catch levels than purely biological phenomena. In addition, salmon stocks are prone to inexplicable and sometimes violent oscillations in abundance which can make a mockery of painstaking attempts to predict future directions of the fisheries. Enhancement activities are also unpredictable in their results; success has very often come virtually by accident while well planned efforts to achieve certain concrete enhancement objectives frequently fail despite great care and imaginative planning.

In the light of the foregoing, it is evident that any attempts at long-term forecasting must be considered as extremely tenuous and should be subject to constant review. The present paper is written primarily from a biological perspective and the authors have made no attempt to speculate on future market trends. Nor have they speculated on future political activities such as negotiations with Japan regarding future high seas fishing activities or the future course of cooperation between Canada and the United States, hopefully within the framework of a new treaty.

The authors feel that all that can reasonably be done is first, to describe recent events in the fisheries in order to assess the likely impact of such events on production in the near term, and second, to comment on possible effects of existing plans or apparent policy trends with respect to the medium term. At the request of the Scientific Authority, an attempt has been made to speculate on "optimistic" and "pessimistic" scenarios of production trends between now and the end of the century for both Japan and the USSR.

As a general comment, it can be noted that, on a global level, production of all 5 species of salmon in recent years has been below historic highs. This would imply that in general, there is considerable room for expansion. At the same time, however, local production (at least for some species), is at an historic peak in both Japan and Alaska.

4.1 Japan

Since very early in its development, the Japanese salmon fishery has depended mainly on fish bound for other countries (initially the USSR but both the USSR and the United States after

World War II). Extensions of jurisdictions by the USSR and the United States in 1977 and recent negotiations within international Commissions, have led to serious limitations of Japanese intercepting fisheries in the past few years. For example, catches of sockeye in the Japanese high seas mothership fishery have fallen from well over 10 million in the 1950s and 1960s to around 2 million in recent years. Offshore catches of pinks have fallen from an average of well over 50 million per annum to 15-20 million in the most recent decade for which information is available. Chum catches have dropped from 7.5-13 million to 2-4 million. Catches appear to be stabilizing at the aforementioned lower levels, but pressure from the USSR and the United States for further limitation continues. Declines in Japanese high seas catches are probably not due entirely to decreased fishing opportunity. There is little doubt that the effect of heavy fishing by both Japan and the USSR on USSR-bound salmon has resulted in conservation problems with resultant decreases in stocks, particularly sockeye and chum salmon. As shown earlier, the total production from USSR rivers for the latter two species is well below historic highs and is not showing signs of any dramatic recovery. Pink salmon production in the USSR (supported by enhancement), does appear to be showing some signs of increase, but is still far below historic highs. In the near term, it can be expected that Japanese high seas catches will not increase significantly and, depending on political and economic factors, they could even decrease. Offsetting this downward trend in the high seas catch is the phenomenal increase in chum salmon production in Japanese hatcheries. As shown in Table 2, contributions of chums from Japanese rivers have increased tenfold over the past 15 years; the 1983 total commercial production of Japanese chums (including a small high seas catch), amounted to 35 million fish. It is apparent that, to a considerable extent, the future of the Japanese salmon fishing industry is dependent on the nation's hatchery program.

In view of its importance, it would seem worthwhile to review the development of the Japanese hatchery program in some detail. The Japanese have a strong tradition of fish culture. As outlined by Taguchi (1967) and Moberly and Lium (1980), records of stream improvement work and transport of salmon in attempts to increase salmon production date back to the 1700s. The modern Japanese enhancement program began in 1889 with the construction of a hatchery at Chitose, near Sapporo, the capital of the island of Hokkaido. The design was based on United States hatcheries and was the precursor of a chain of hatcheries operating around the northern island of Hokkaido; by 1910, as many as 50 hatcheries were in operation. It is beyond the purview of the present report to recount the operational and institutional history of the Japanese hatchery system; Moberly and Lium's succinct account is recommended to those wishing more detail. Briefly, the island of Hokkaido has until very recently been the main center for propagation activity. The program there is carried out mainly under the auspices of the Japanese National

Government which operates the principal hatcheries on the Island, but fishermen's organizations also play an important role. In Honshu, hatcheries have been constructed and operated mainly by the private sector (with subsidies from national and prefectural governments). Development in Honshu has accelerated in recent years but for many years it lagged far behind that in the northern Island. In the late 1970s, 90 hatcheries operated in Hokkaido (37 national, 2 prefectural and 51 private - the latter mainly small). In Honshu, 111 hatcheries operated during the same period, virtually all of them small, private operations.

Chums are by far the most abundant species of salmon found in Japan, and the chief target of the hatchery programs in both Hokkaido and Honshu. Recent data are not available but in the mid-1970s, about 80% of the salmon handled in the hatcheries were chum salmon and the remainder were mostly pinks. Because virtually all the rivers of Japan have been altered for agricultural or industrial purposes (e.g., for irrigation and waste disposal), and because human population in the lower reaches of most rivers is extremely dense, the natural habitat of salmon throughout Japan has been almost totally destroyed. Very little natural spawning occurs and almost all of the chum salmon produced in Japan originate in hatcheries.

Figure 12 shows the numbers of juvenile chum salmon released from Japanese hatcheries since the first permanent hatchery was established in 1889 (data for Honshu are only available from 1948 onward). Table 3 lists similar data for 1950-1983. Until the mid-1960s, most juveniles were released as unfed fry but beginning in 1962, substantial numbers of young fish were held and fed in retaining ponds before being released.

The results of the program have been dramatic. Estimates of total returns of chums to Hokkaido from each year's juvenile release (estimated by comparing the numbers of juveniles released with the resultant adult return by age class 2-6 years later), are listed in Table 4. The Table shows that prior to the 1966 brood year, juvenile to adult rates of return averaged 1.14% (ranging between 0.47 and 1.83%). From 1966 (the first year that the majority of the juveniles were fed - see Table 3) onward, the average rate of return more than doubled (to 2.4% for the 1966-1977 broods).

From 1950 through 1980 there was a steady increase in the numbers of juveniles released. Between 1980 and 1983, the numbers of fry released in Hokkaido leveled off at about 1.1 billion per year. In recent years, with return rates remaining steady or possibly increasing (the all time high of 3.05% was reached with returns from the 1977 brood year), the numbers of adults returning have reached phenomenal levels. As shown in Table 2, the estimated catches of Japan-bound chums in Japanese coastal waters have risen from a level of 2-3 million fish in the early 1950s to over 33 million in 1981.

The analysis outlined in Table 4 (based on data provided to INPFC by Japanese hatchery authorities), compares returns on a brood year by brood year basis for Hokkaido only. Such an analysis requires data on the age composition of the catches. Age composition data were not available to the authors for the increasingly important coastal and river fisheries of the Japanese main island of Honshu. It was therefore not possible to conduct a precise brood year by brood year analysis for Japanese chum production as a whole. A less precise approach is possible, however, if one compares the numbers of juveniles released to the adult return 4 years later (on the average, the majority of Japanese chums tend to return as 4-year-olds). Table 5 provides such an array of data. The results parallel those shown for Hokkaido alone in Table 4. Rates of return were generally higher after 1968, reaching a peak of 3.18% for the 1976 brood year. The rates for the succeeding three brood years dropped off somewhat, averaging about 2.6%. In general, however, the apparent rate of return has been relatively constant for brood years 1968 through 1979, varying between 1.77 and 3.18% and averaging 2.45%.

The numbers of juveniles released during 1980-1983 were substantially higher than in the previous four years (an average of 1.9 billion compared to 1.1 billion during 1977-1980). If the return rate remains at about the 1968-1979 level (2.45%), continued increases in coastal returns can be expected. In Column V of Table 5, for the 1980-1983 brood years, the average return rate for 1968-1979 is applied to the appropriate juvenile releases to provide estimates of the possible levels of adult returns in 1984 through 1987. The calculations provide estimates of between 44 and 49 million chums, substantially higher than the record level for 1983 (33 million fish returning to Japanese waters). It should be noted immediately, however, that, based on preliminary information, the 1984 coastal return (not included in the Table) fell far short of such projections and indeed, was less than the return in 1983.

The Japanese coastal catches tell only part of the story, however. Tagging and scale studies (e.g., Shepard et al. 1964), show that significant numbers of Japanese chum salmon are intercepted in Japanese offshore fisheries. Gross approximations of such interceptions are listed in Table 2. When high seas catches are included with coastal catches of Japan-bound chums, the overall rate of return obviously increases (to an average of 2.6% in the post-1966 period - Column IX of Table 5). The estimated high seas catches of Japan-bound chums increased from around 200,000-500,000 fish in the 1950s to a peak of over 3 million in 1976 (listed against brood year 1972 in Table 5), accounting for about 20% of the total catch. High seas catches have declined since then as the result of limitations placed on Japanese offshore fisheries in the wake of the 1977 declarations of 200-mile fishing zones by the United States and the USSR.

For the near term, the most pressing question is whether or not the juvenile to adult return rates will remain at their recent high levels. As mentioned above, 1984 returns were disappointing, perhaps indicating a continuing decline in return rates. In the longer term aside from biological questions, there is the question of development policies that may be adopted by the Japanese authorities. With respect to the latter, through INPFC, the authors requested information from Japanese hatchery authorities regarding future plans. They were informed that the program was currently under intensive review, and that plans resulting from this review would not be known for some months.

It is worthy of note that, as noted above, regardless of future trends in survival rates, after a rapid increase in juvenile output through 1980, Hokkaido hatchery fry releases have more or less leveled off during the past four years. Releases from Honshu, however may continue to rise. Comments in Japanese fishery periodicals (e.g., Anon 1976) provide interesting background for consideration of the future. A 1976 article noted that with existing advances in technology, "... it should be possible to supply the entire Japanese demand of 150,000 tonnes". If the projections in Table 5 hold for 1985 and beyond (despite the disappointment of the 1984 return),that target could soon be reached. The Japanese undoubtedly remain optimistic about their program. A 1983 newspaper article expressed the view that the level of the 1983 return was "... only a passing point and judging from the number of chum released, the highest figure will be renewed year by year. Now it has become more important to develop better marketing systems to enhance demand for salmon because the amount of consumption is now at a plateau".

In short, Japanese hatchery programs for chums have resulted in increases in production to levels far beyond those existing before (reaching about 35 million fish in 1983). If existing survival rates were to be maintained, it would appear that chum salmon production would statilize over the next few years at between 40 and 50 million fish. This could be an optimistic appraisal since such production levels are far higher than have ever been produced naturally from Japanese rivers; it is possible that survival rates might drop with the increased fry output of the 1980-1983 period. Indeed, preliminary reports indicate that the 1984 hatchery returns were below those of 1983. Beyond the next half decade, further expansion might be possible if survival rates remain stable and if market conditions are favourable. There is no way to predict what the limits of such expansion might be.

If one were to take a pessimistic point of view, might be projected a further retrenchment of the Japanese distant-water fishery would occur, reducing catches from present levels, and that hatchery production of chum salmon would remain at existing levels (assuming that the saturation point, either from the biological or market point of view, had been reached).

On the other hand, if one were to take an optimistic view, although high seas fishing opportunities are unlikely to expand, the health of a number of currently depressed USSR stocks could improve, resulting in increases in Japanese catch/unit effort and an overall increase in high seas catch. It is very unlikely, however, that high seas catches would ever return to the high levels of the 1950s and 1960s. In an optimistic vein, some further increases in chum salmon catches beyond the 40-50 million discussed above could occur if the physical capacity of the hatchery system were expanded. Diversification of the hatchery program toward other species (e.g., chinook) could also provide opportunities for increase.

Taking a middle-of-the-road viewpoint, it would seem reasonable to consider that high seas catches would remain at about current levels for at least the next few years. Beyond that period, considering the high cost of distant-water fishing, the high seas fishery catch would be unlikely to increase and could well decline. For the hatcheries, some increase of chum production over the recent 35 million level might be anticipated considering the increased number of juvenile fish that have already been released. Increases beyond that point are unpredictable and probably mainly dependent on markets. In any event, quantities produced are very likely going to be sufficient to meet local Japanese demand for chums. Diversification to other species is a possibility.

4.2 USSR

As shown in Table 1 and Figures 7-11, at peak production the USSR provided more salmon than any other Pacific Rim country (twice as many pinks and four times as many chums as any other area). Current levels of production from USSR rivers for all species (measured in terms of the decade 1973-1982), are well below historic highs. Historically, the Kamchatka Peninsula (mainly the west coast), provided the majority of the salmon caught by both the USSR and Japanese fisheries operating along the USSR coast. Coincidentally with the growth of the Japanese high seas fishery operating mainly in the North Pacific off the Kamchatka coast, USSR catches of all species in the Kamchatka area declined disastrously in the 1950s and 1960s. As noted in Section 4.1 above, restriction of the Japanese high seas fishery has resulted in some recovery in the USSR fishery, but this has been limited mainly to pink salmon and, as will be shown below, mostly to the Sakhalin-Kurile Islands area (See fronticepiece map). The latter area is the main area of concentration of the USSR salmon enhancement program.

As background for assessing possible future trends in production from USSR rivers, a brief review of past catch patterns in the Sakhalin/Kurile area would seem warranted. Before World War II, Japan operated substantial shore-based fisheries on Sakhalin and in the southern Kuriles, territories which were under Japanese jurisdiction. Both countries carried

out fisheries in the coastal areas of the northern part of Sakhalin. During 1926 through 1936 (the only pre-war years for which records of catch by District exist for both Japan and the USSR), annual catches of the inshore Sakhalin/Kurile fisheries of the two countries combined varied between 7 and 28 million pinks (Table 6). During the early years of the war, the Japanese fishery declined (1943 being the last year it was prosecuted). The Soviet fishery made only small catches in the area until 1947, when over 20 million pinks were taken. The Soviet catch rose to over 30 million in the next odd year (1949), a record catch for the area up to that time. The catch in 1951 was also high (almost 23 million). During this period of odd-year abundance, even-year catches were much smaller (between 3 and 6 million). From 1953-1957, the odd-year catches again declined but came back strongly from 1963 through 1975 (the catch in the last mentioned year was almost 42 million). The even-year catches dropped in the 1950s but recovered strongly in 1972 and 1974. For the post-1975 period, catch data by District are available only for 1978 and 1979; in 1978, the catch (22 million) was the highest it had been since 1956 but the 1979 catch (17 million) was lower than any since 1967. In general, the data are suggestive of some alternation in the strength of even and odd-year runs; the two cycles rarely seem to perform at high levels during the same period.

To trace the general trend of the fishery, it would seem appropriate to examine the catch on a biennial basis (i.e., combining successive even and odd-year catches). Table 8 shows that aggregate even/odd-year catches in recent years have been higher than at any earlier period in the fishery.

The apparent healthy state of the Sakhalin stocks is in marked contrast to the condition of pink stocks in other parts of the Pacific coast of the USSR. Table 6 lists data on pink catches around the Kamchatka Peninsula and from other fishing areas along the USSR coast. Before World War II, fisheries along the USSR coast were carried out by both Soviet and Japanese fishermen; the Table combines data for both countries. With respect to the Japanese components of the statistics, only data for inshore fisheries are included (in the 1930s and early 1940s, the Japanese conducted some offshore fisheries in the Sea of Okhotsk and off the Pacific coasts of the northern Kurile Islands and Kamchatka). The Table shows that until the mid-1950s, the Kamchatka (mainly West Kamchatka) area provided the bulk of the USSR coastal pink catch (over 70% - see Table 7). In the late 1950s and 1960s (coincidentally with the growth of the post-war Japanese high seas mothership fishery), the total Soviet coastal catch of pinks plumetted, with the Kamchatka catches being the most affected; the percentage of Kamchatka fish in the total catch fell from over 70% in the 1940s (Table 7) to around a third or less of the total in the 1960s. In absolute terms the drop was dramatic; from an annual total of near a hundred million to 5 million or less in the even-numbered years and to 10 million or less in the odd-numbered years. On the other hand,

the relative importance of Sakhalin fish increased; whereas fish from the Sakhalin/Kurile area generally contributed 25% or less to the total pink catch of the pre-war combined Japan/USSR coastal fishery (dropping to less than 10% in the 1940s), the area provided over 70% of the total Soviet pink catch in 1974/75 (Table 7). In 1977, extensions of fisheries jurisdiction to 200 miles by the United States and the USSR resulted in substantial reduction of the Japanese high seas fishery. In 1978 and 1979 (the only post-1976 years for which District catch data are available), catches of pinks in Kamchatka rose substantially over levels of the previous 25 years, perhaps reflecting the effects of this limitation. Nevertheless, catches still remain well below the historic highs of the pre-war period.

As noted above, the Sakhalin-Kurile area, where pink salmon stocks are strongest, is also the focus of USSR enhancement efforts.

The authors have not had an opportunity to carry out a search of recent USSR literature dealing with enhancement activities in the Soviet Union. It is understood that the vast majority of the USSR enhancement efforts are limited to Sakhalin Island itself. A recent article in a Japanese periodical indicates that plans for the immediate future continue to emphasize the Sakhalin operation but that some diversification is contemplated, involving construction of facilities on the mainland coast adjacent to Sakhalin and on the Kamchatka Peninsula to the north. In translation, the article (Anon. 1984) stated:

> "Since concern for decreasing Pacific salmon stocks is becoming serious in the USSR, various measures have been planned under the name of 'the Five Year Program' (1981-1985) to reconstruct the stocks.
>
> "According to a news release made by Freriks Ribcof [F. Ruklov], Chief of the Sakhalin branch office of the Institute of Pacific Fisheries and Oceanography, a total of 1 billion salmon eggs were collected, 940 million in Sakhalin, 43 million in the areas of the Amur River, and 16 million in Kamchatka. A total of 900 million juvenile salmon were released in the Far East Region of the USSR in 1982.
>
> "The program includes modernization of facilities in present hatcheries and nurseries, and construction of new hatcheries and stations. At Maritime Kray (?) near Vladivostock, an experimental station for aquaculture of salmon is being constructed of a type not previously existing in the USSR. Two hatcheries are under construction in Khabarovsk and Sakhalin and two more hatcheries are to be built in Kamchatka and Sakhalin."

A United States scientist, Colin K. Harris of the Fisheries Research Institute of the University of Washington, visited the USSR's Pacific Scientific Research Institute of Fisheries and Oceanography (TINRO) in May 1983. Information he obtained at the time presents a similar picture of the present status of the USSR enhancement program (pers. comm. 1984). During Harris' visit, he was informed that 90% of the artificial propagation of salmon carried out in the Soviet Union is conducted on Sakhalin Island. He reports that firm plans exist for expansion of hatchery operations, including replacement of some of the existing hatcheries. Plans for the next five years include increases of production of pink fry to 2,115 million and of chum fry to 840 million (from existing levels of about 900 million total production of both species). In addition it is planned to rear 59 million masu salmon fry, 60 million coho (on East Sakhalin) and 50 million sockeye (the latter on Iterup Island in the Kuriles).

A very ambitious statement of Soviet plans was included in a news release quoted recently in The Fisherman (August 17, 1984 issue):

> "Soviet scientists are concentrating on natural reproduction in their efforts to increase salmon production to 500,000 tonnes a year by the year 2000, according to economist Yevgeny Markevich.
>
> "In a recent report for APN, the Soviet news service, Markevich predicts salmon landings will increase by four or five times thanks to hatchery and natural production.
>
> "The USSR's 25 fish farms on the Pacific coast account for one-third of the entire world output of salmon fry, or about one billion fish a year. Production has increased 10 times since 1945.
>
> "Production increases are based on a comprehensive salmon program, Markevich writes, 'provides for the commercial breeding of this fish on the basis of the 100 percent industrialization and mechanization of all processes, the protection of the zones of the habitat of salmon, the recovery and improvement of natural spawning grounds and the creation of new ones.
>
> "Hatchery programs in parts of the Soviet Far East have raised pink runs to the point that even and odd-year cycles are equal in strength. Eighteen new hatcheries are under construction and 15 are being renovated to allow doubling the output of salmon fry."

A recent Soviet report (Ruklov 1982) discusses the USSR enhancement program in the Sakhalin/Kurile area. Figure 13 (copied from the paper) illustrates increasing egg takes of pink salmon (about 600 million in 1979) and more or less stable levels

of chum egg take from mid-1960 through 1979 (around 250 million). According to Ruklov, most of the young fish were released in the southern part of Sakhalin (Aniva Bay, at the southernmost end of Sakhalin Island) and from Iterup Island in the southern Kurile chain. Historically, more chum were released than pinks. Ruklov made estimates of the proportion of pink salmon juveniles emigrating from rivers in southern Sakhalin and Iterup Islands that were contributed by the hatcheries. During 1973-1977, he estimated that 12-39% (average 23%) of the young pink in southeast Sakhalin, 17-50% (average 31.2%) of those in Aniva Bay and 18-51% (average 31.6%) of those at Iterup Island had come from the hatcheries. It can be seen from Figure 13 that pink salmon releases climbed more or less steadily from the mid-1950s through 1979, but the most pronounced increase was from 1973 through 1980 when the total egg take increased about 50%.

From perusal of the production trends in Figures 6-10, it would seem that the modest resurgence of pink salmon represents the only bright spot in the salmon fisheries scene along the USSR coast. Other species appear to remain in a relatively depressed state, not much better than they were at the peak of the Japanese high seas fishing activities which depended mainly on USSR-bound salmon. Over half of the improving pink salmon catches come from the Sakhalin-Kurile area, an area that was not formerly the focus for production of any species along the USSR coast. Originally the Kamchatka Peninsula and the northern Okhotsk Sea coast were the most important producing areas for all 5 of the trans-Pacific species of salmon but catches in the these areas remain dismally low. Although enhancement efforts around Sakhalin have undoubtedly contributed to the improved performance of the pink runs there, it is unlikely that these measures account for all of the resurgence. As outlined above, USSR scientists attribute the hatcheries with only about 20% of the Sakhalin-Kurile production. Limitation of high seas fishing in the Pacific may also have played a role. Artificial propagation of other species in the USSR does not seem to have been demonstrably successful. In contrast to the Japanese experience (See Section 3 above), relatively large releases of chum salmon fry have apparently provided little in the way of improved catches. Prior to World War II, 1-3 million chums were caught in the Sakhalin/Kurile fisheries. Catches dropped to less than a million following the war and to the low hundreds of thousands throughout the 1970s. For a number of recent years (including the latest ones for which data are available, 1978 and 1979), no catches have been recorded, suggesting that the fishery for chums has been closed, perhaps for conservation.

Thus, current USSR enhancement activities are concentrated in an area remote from the former main producing areas in the USSR (Kamchatka and the northern Sea of Okhotsk coast) and are largely limited to one species. It seems unlikely, therefore, that starting from this point, enhancement as presently practised in the USSR can be sufficiently geared up

and operationally diversified (with respect to areas and species) to play any more than an incidental role towards achievement of the 500,000 tonne target decribed above, at least within the next few years.

Even if the hatchery program did provide substantial support in the near term, the quoted objective of 500,00 tonnes per annum would seem to be extremely optimistic. Since the USSR and the United States extended their fisheries jurisdictions to 200 miles in 1977, USSR coastal catches have averaged about 100,000 tonnes per annum. If one looks at total production from USSR rivers (i.e. considering Japanese interceptions as well as coastal USSR catches), the average annual harvest during 1973-1982 was about 140,000 tonnes (of which the Japanese took about a quarter). Considering catches of each species during peak decades of production (Table 1), the maximum aggregate production of the 5 species from USSR rivers was in the order of 144,000 tonnes. During the decade 1973-1982, the average annual global catch of Pacific salmon was only 476,000 tonnes. Thus the Soviets aspire to produce more salmon than are now being caught in aggregate around the world, a feat that would involve increasing their catches three and a half times. Achievement of such a goal within the next decade or two would therefore seem to be very ambitious.

Labeling the Soviet objectives as "very ambitious", should not be interpreted as meaning that major increases cannot or will not be achieved in the Soviet Union before the end of the century. Even without enhancement, substantial increments are possible through improvements in management. As pointed out in the previous section dealing with Japan, the major runs to the USSR have probably been overfished since the 1950s and 1960s. Limitations on the Japanese intercepting fisheries are providing some relief, but the authors are not familiar with conservation measures currently being taken by the Soviets with respect to their own fisheries. Nevertheless, it is likely that affected stocks will respond positively to recent reductions in fishing pressure. How fast they will recover is hard to predict.

With a pessimistic outlook, one might be very skeptical about the potential of the USSR enhancement program and doubt that much rebuilding of natural stocks through management will occur. On the other hand, with the pressure of the Japanese high seas fishery reduced, one would not expect a deterioration of the runs. Thus, one would at least expect future USSR catches to be no lower than they are now, and it is probable that they could be slightly higher.

If one were to take an optimistic view and consider very seriously recent USSR statements concerning efforts to be made to increase the runs (particularly through enhancement), one might look at the Japanese model and believe that within 15 years, substantial increases could be brought about by use of hatcheries. Even so, it would take at least 5 years to bring

about a major expansion and full benefits would probably not be achieved in the 10-odd years remaining in the century. One might consider, however, that pink salmon production on Sakhalin could be doubled through concentrated enhancement (from about 25 million to 50 million) and that more modest gains could be made elsewhere. With respect to natural production, the immense potential of the Kamchatka Peninsula and other Soviet producing areas might be realized sooner than expected if spawning escapements were given special protection. Pink salmon (which always provided the bulk of Soviet salmon production) are very volatile and could show a surprising resilience. Restoration of pink production to historic levels would add around 130,000 tonnes to total catches (some of which would be taken by Japanese fisheries). Overall, regardless of how optimistic one is, it is hard to believe that a target of 500,000 tonnes a year could be achieved in the near term. Nevertheless, an optimist might consider that with the assistance of enhancement, production in the USSR by the end of the century might be restored to levels not far below historic highs (perhaps approaching 400,000 tonnes, mainly pinks), some of which would be taken by Japanese fishermen.

Taking a more conservative but not pessimistic view, one is impressed with the immensity of the salmon resource potential of the USSR, particularly for pink salmon. With their fisheries limited to the rivers, the Soviets have the potential of achieving the kind of stock by stock management that is extremely difficult in North American fisheries where a substantial part of the harvest is made on mixtures of stocks in fishing grounds remote from the rivers. While it is true that Japanese fisheries still intercept USSR-bound chums and that a substantial part of this catch is made in Japanese waters, the USSR should have a very good chance of building up escapements to higher levels. It would probably take several generations to see the full impact of an improved management program. As outlined above, on the basis of knowledge available to the authors, it is hard to see how in the 15 years remaining in the century, an enhancement program aimed at restoring the major northern runs of the USSR coast could be brought fully into play. Nevertheless, the program has already made a substantial contribution to production in the Sakhalin area and could provide further increases in the future. Overall, it is a real possibility that many of the USSR runs will be well on their way to recovery by the end of the century and that total production of about double the recent yields might be achievable (perhaps in excess of 250,000 tonnes, a portion of which would be intercepted by Japanese fishermen).

4.3 Alaska

In recent years Alaskan catches of all 5 species have been at very high levels. Within 1980-1983, record annual catches for single years have been set for sockeye and for coho. Catches of pinks in both even and odd-numbered years have

recently been higher than in any years since 1940 and 1941. Recent catches of chums have also been higher than any since the early 1940s and chinook catches have been greater than any since the late 1930s. The aggregate catch of salmon in 1983 (not reflected in Table 1) was the greatest ever achieved. The healthy state of the Alaskan resource has been ascribed to sound management practices and unusually favourable environmental conditions. Alaska has a moderately scaled enhancement program. Initiated during the early 1970s when Alaskan runs were at very low levels, high catches from recent large natural runs have reduced the urgency of the program, and expenditures for it have been reduced. While serving to meet needs in particular parts of Alaska and of particular user groups, the program currently makes a relatively small contribution (about 4% of the total Alaska harvest) to the large total production of the State (127 million salmon in 1983).

It is difficult to predict the future directions of Alaskan harvests. There is little doubt that much of the decline that occurred in Alaskan fisheries after peak catches were made in the 1930s was due to overfishing and that Japanese high seas fisheries intercepting salmon bound for Western Alaska (primarily Bristol Bay sockeye) reduced United States harvests of Alaska-bred salmon prior to the mid-1970s. Increased attention to providing greater spawning escapements and limitations of the Japanese high seas take (which before the cutbacks exceeded 6 million fish in several years), undoubtedly have improved the background for salmon management in Alaska, a situation that will probably result in the maintenance of higher catches than were achieved during the doldrum period extending from the end of World War II through the early 1970s. In contrast to watersheds to the south, particularly in Washington and Oregon, virtually all Alaskan salmon producing systems have been little affected by environmental degradation. Environmental conditions in Alaska as they may be affected by man, are therefore very favourable. The importance of natural fluctuations, however, cannot be minimized. In the record year of 1983, the catch of Bristol Bay sockeye accounted for fully 31% of the entire Alaska salmon catch. The Bristol Bay sockeye have a history of boom and bust production that defies explanation. Similarly, pink runs, at least in recent years, have undergone extreme oscillations that cannot be associated with management actions taken in any particular year. The best that can be said is that conditions for maintenance of Alaska runs have improved substantially in recent years and that it would be surprising if Alaska salmon production declined to the levels existing in the 1950s, 1960s and early 1970s. Whether or not existing high levels of production can be maintained or even increased is a matter of conjecture.

4.4 Washington, Oregon and California

The dedication of waterways to uses other than fisheries has resulted in massive programs of amelioration in the States of

Washington, Oregon and California. Despite their scale, these efforts have fallen short of maintaining the fish producing capacitities at former natural levels. Pacific salmon production in the Northwest United States has suffered a steady decline creating problems that have been complicated by the fact that substantial portions of the chinook and coho salmon production are harvested by Canadians and, in the case of chinook, by other United States citizens in Alaska. The major enhancement efforts undertaken by the United States are in a state of reappraisal. Financial stringencies, failure to resolve problems of interceptions in Canada and Alaska, and questions of priorities with respect to meeting the needs of user groups, have led to a period of consolidation of existing enhancement operations and a moratorium on the launching of major new initiatives. In the meantime, production has continued to fall. Resolution of existing administrative, diplomatic and political difficulties may lead to an expansion of enhancement activities but, in view of the problems faced, it will be very difficult in the medium term for the programs to do more than make up for the losses that have occurred in recent years.

5.0 ATLANTIC SALMON

World-wide commercial catches of Atlantic salmon from 1930 through 1983 have amounted to less than 15,000 tonnes annually (Table 9). Recently, however, marine culture of Atlantic salmon, particularly in Norway, has led to a substantial increase in supplies of Atlantic salmon for world markets. Table 10 below lists production from ranching facilities in Norway and the United Kingdom in recent years. Attempts at marine culture of Atlantic salmon have been made in a number of countries outside Europe, including Chile, New Zealand and Canada.

It is of note that marine culture facilities are now producing a greater weight of Atlantic salmon than are caught in commercial fisheries. To provide a perspective, the combined landed weight of coho and chinook in British Columbia in the last few years has amounted to about 15,000 tonnes, less than the production of Atlantic salmon from the European culture facilities.

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FIGURES

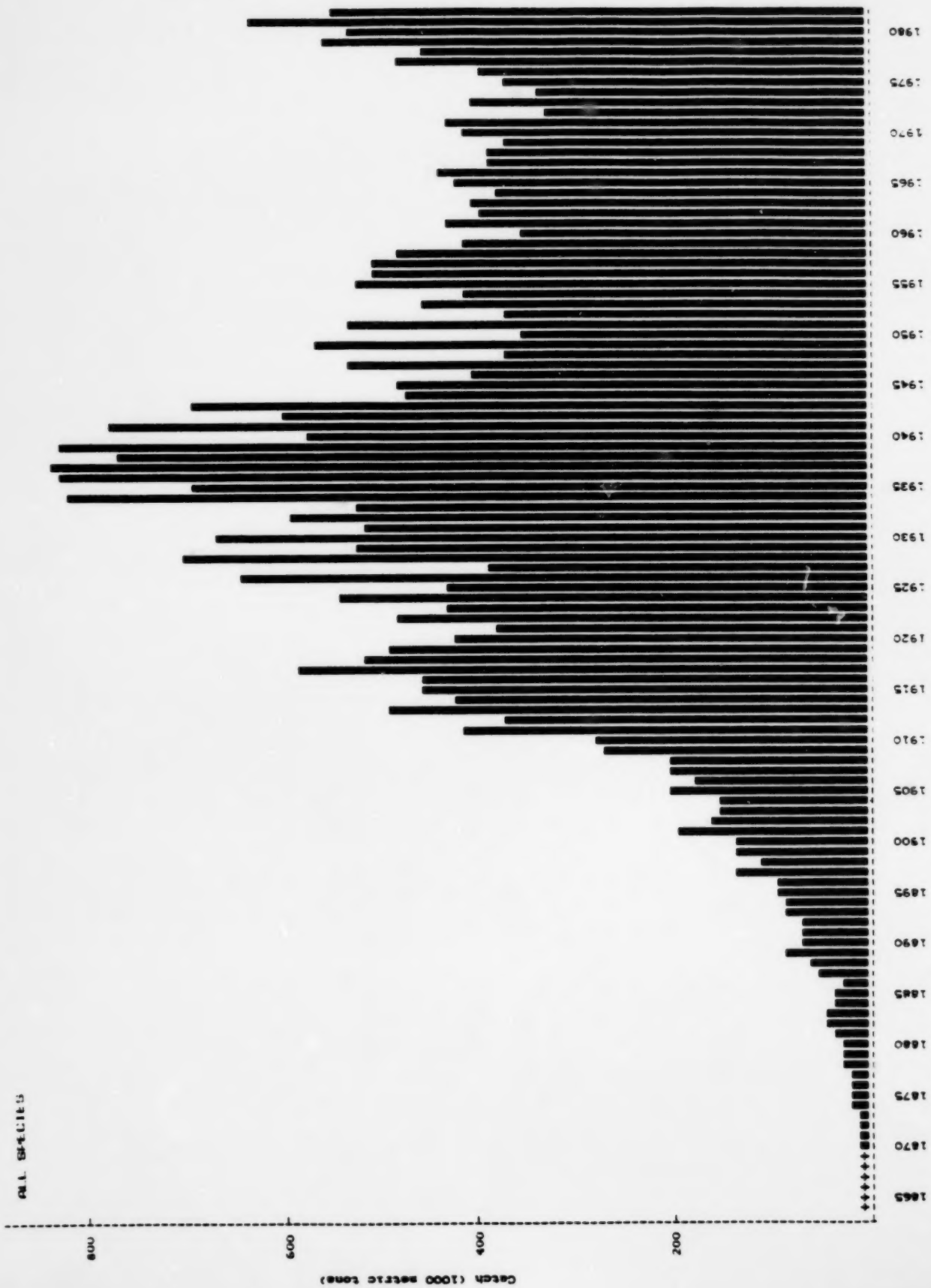

Figure 1. Total landings of Pacific salmon througout the North Pacific Area.

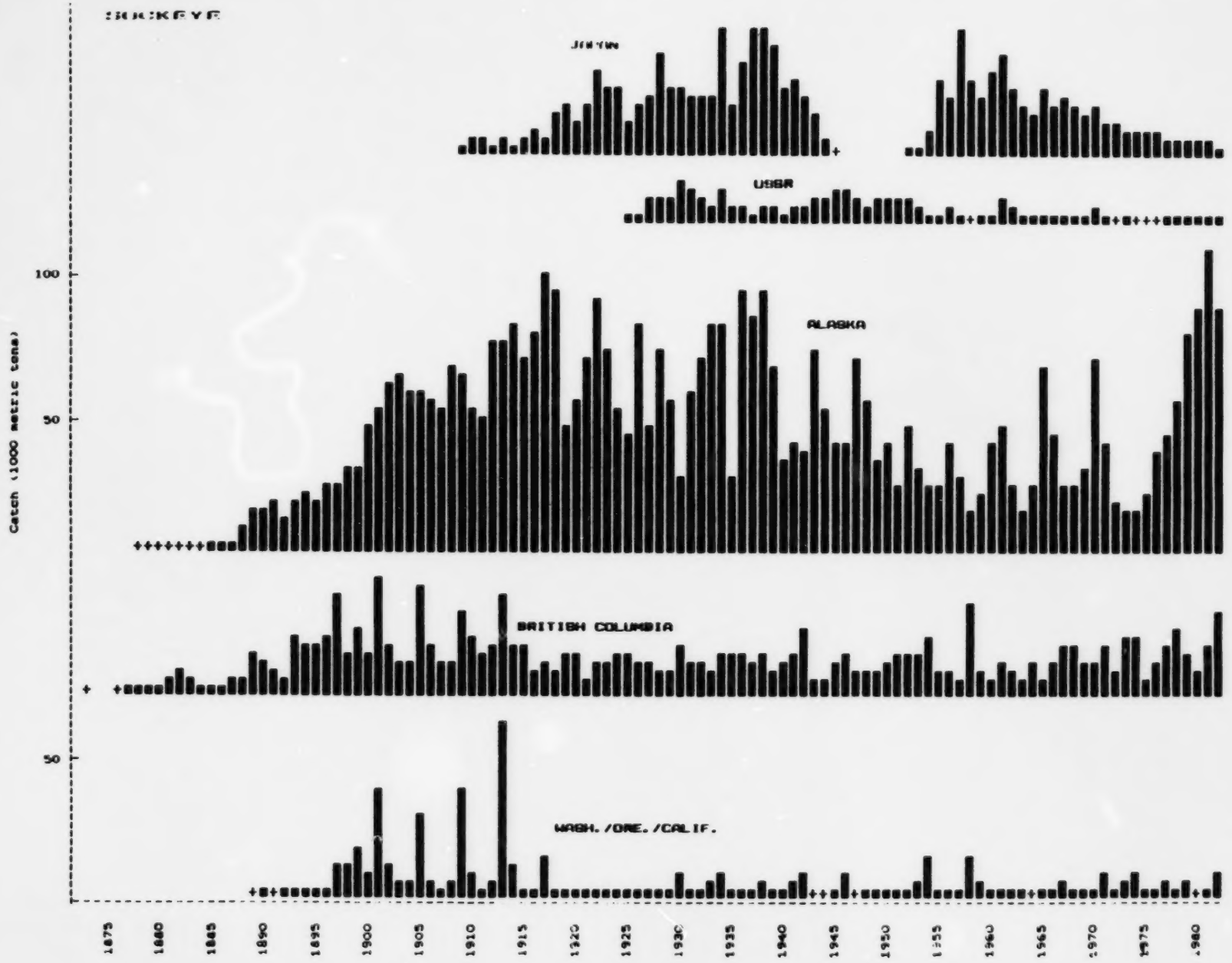

Figure 2. Commercial landings of sockeye salmon in the North Pacific, by country.

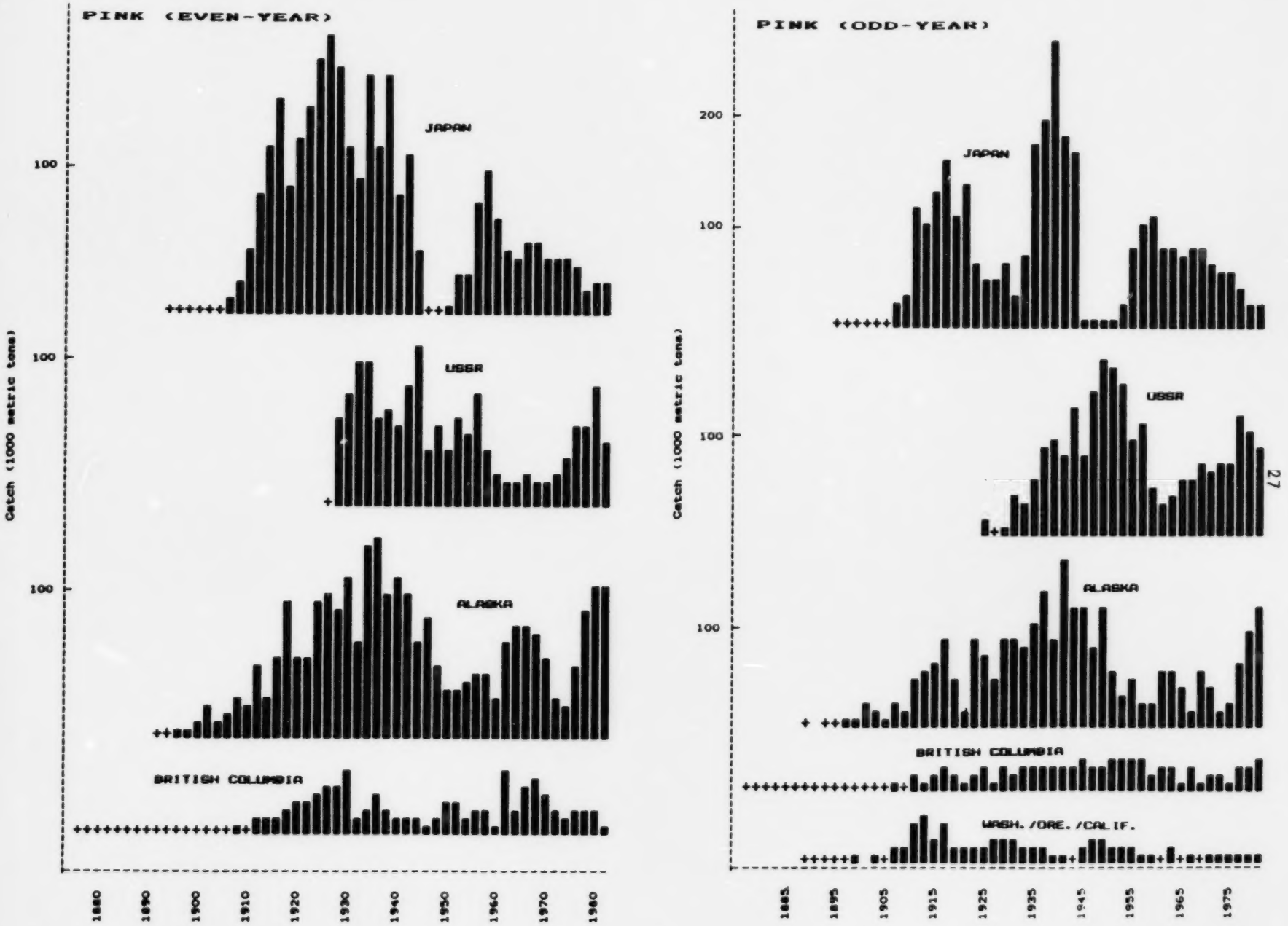

Figure 3. Commercial landings of pink salmon in the North Pacific, by country.

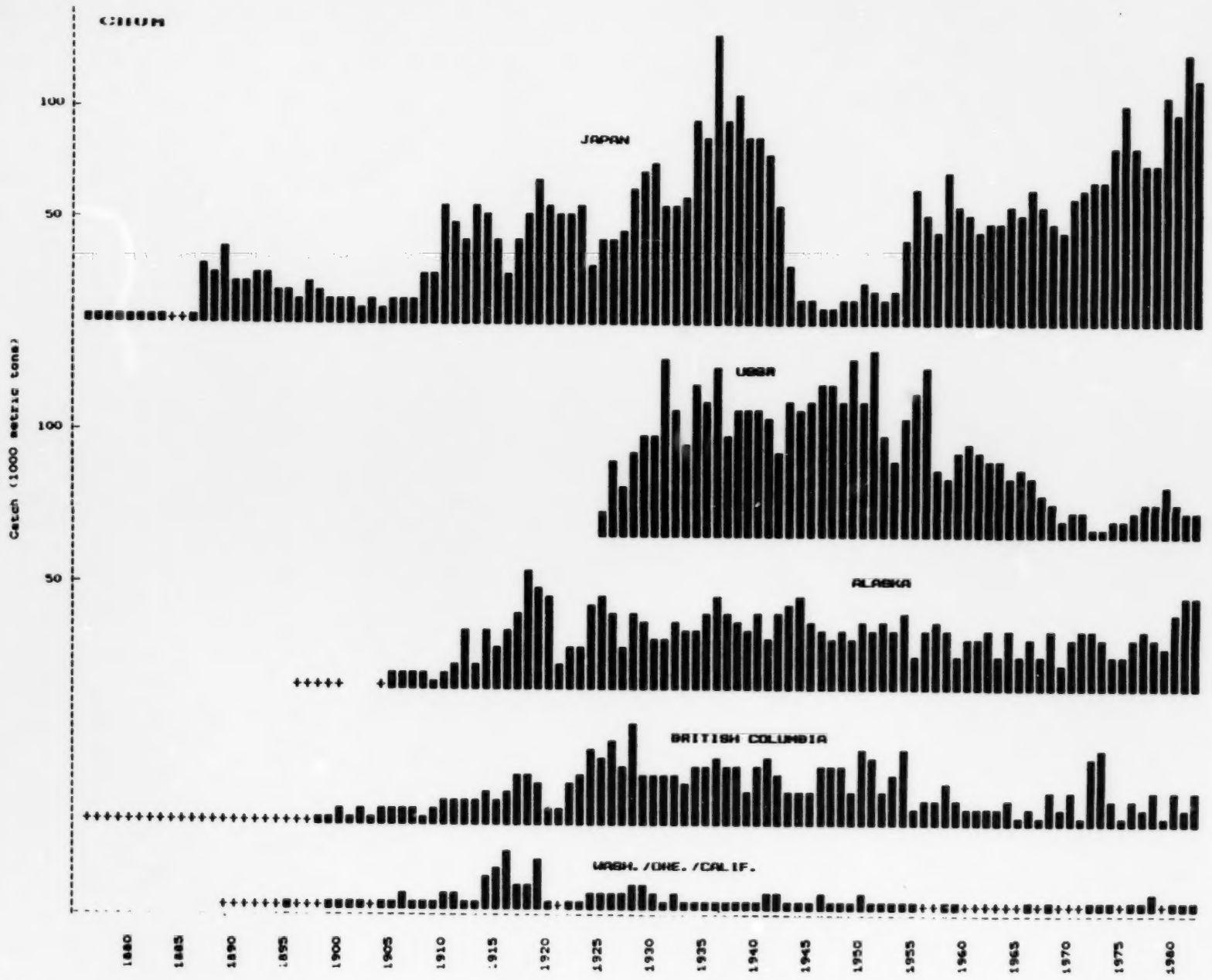

Figure 4. Commercial landings of chum salmon in the North Pacific, by country.

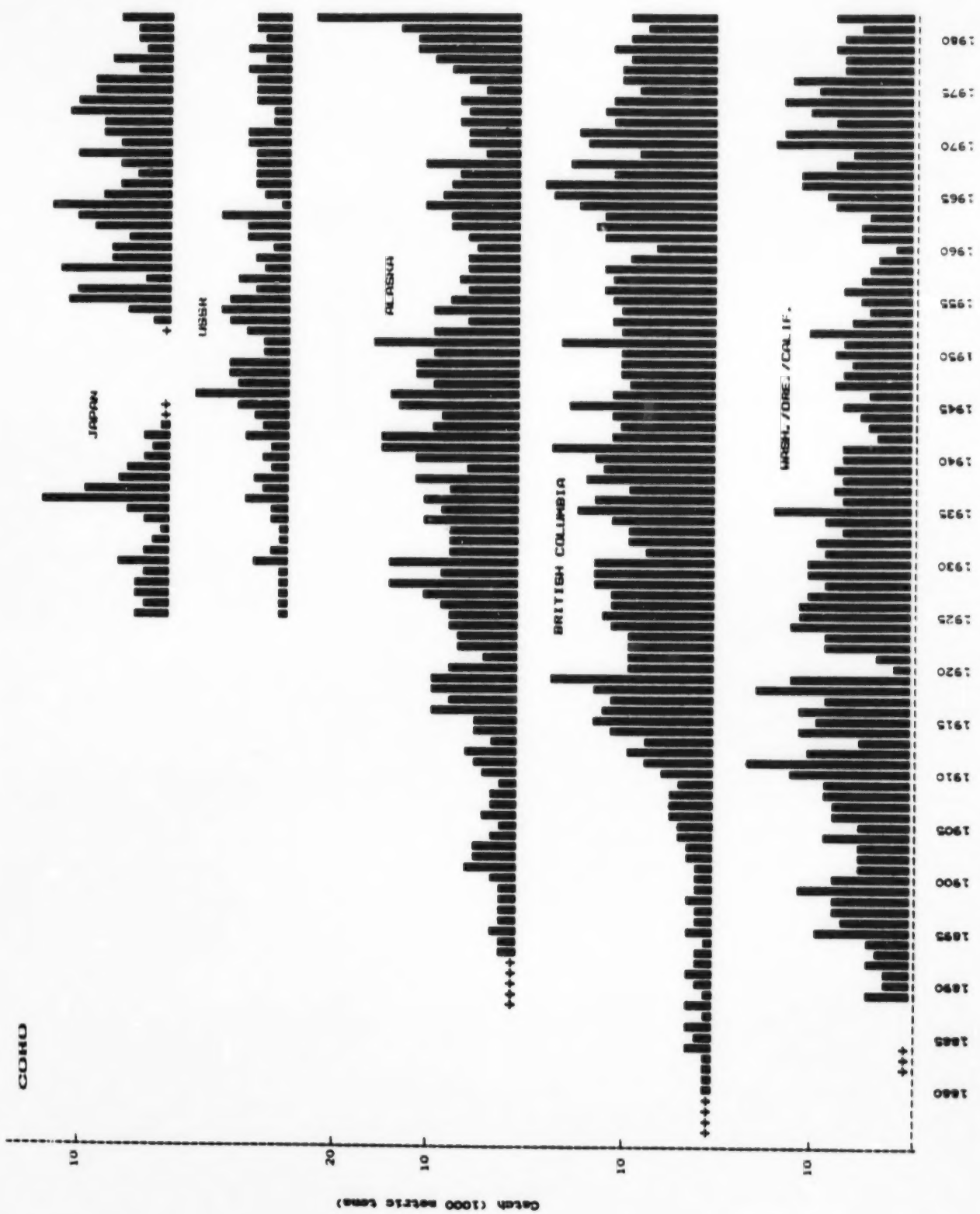

Figure 5. Commercial landings of coho salmon in the North Pacific, by country.

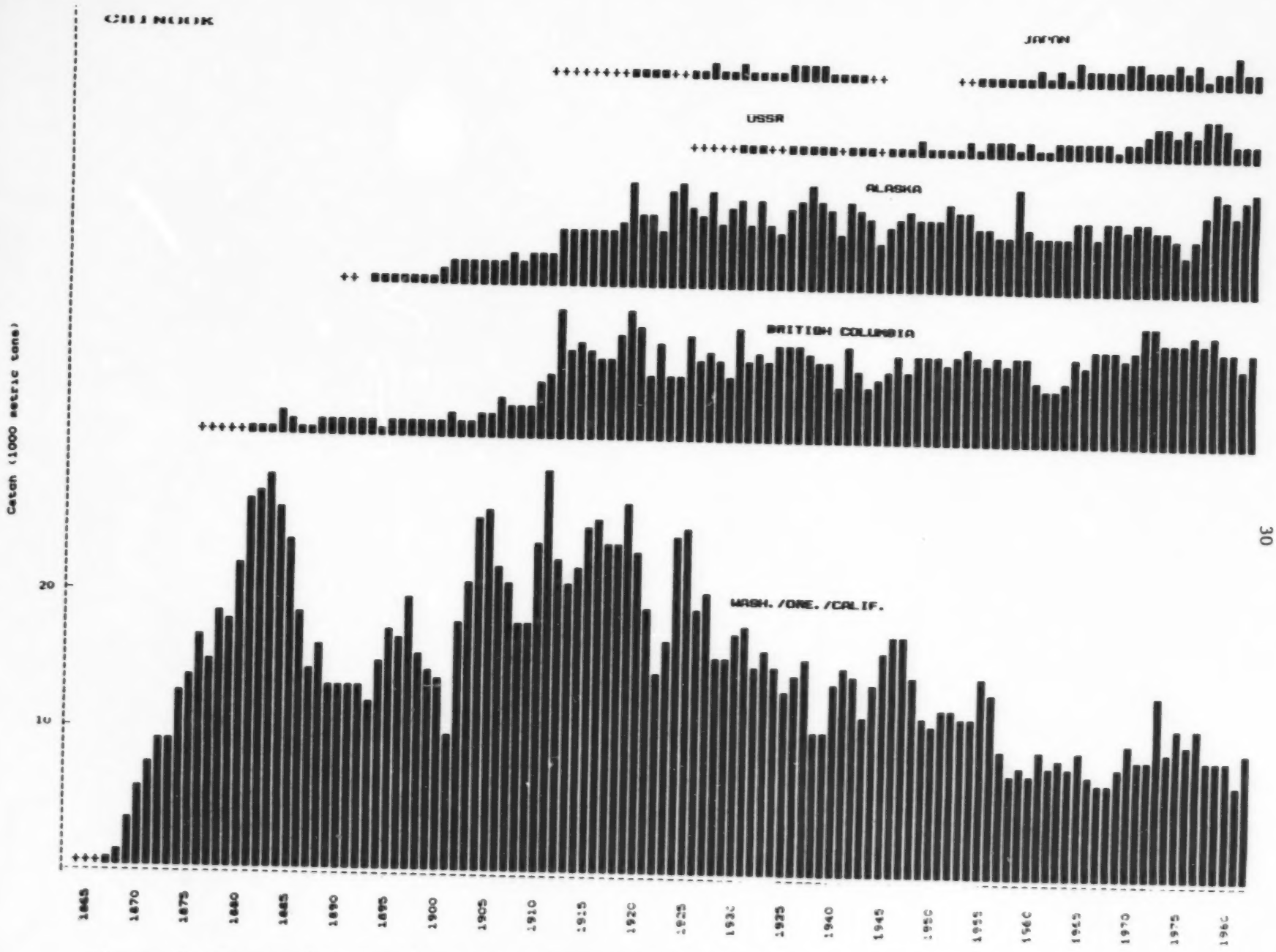

Figure 6. Commercial landings of chinook salmon in the North Pacific, by country.

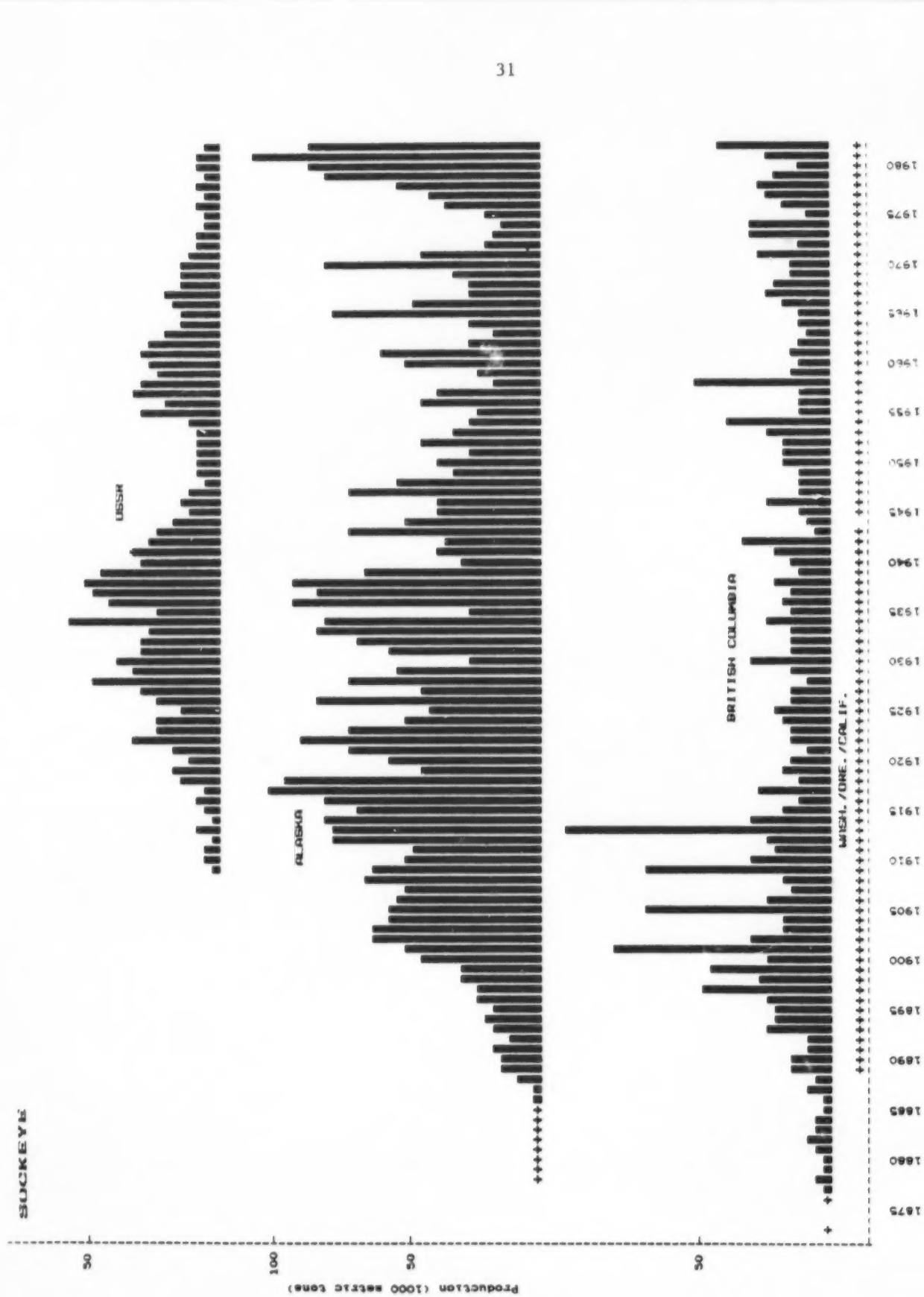

Figure 7. Estimated contributions of sockeye salmon originating in different areas, to commercial fisheries of the North Pacific.

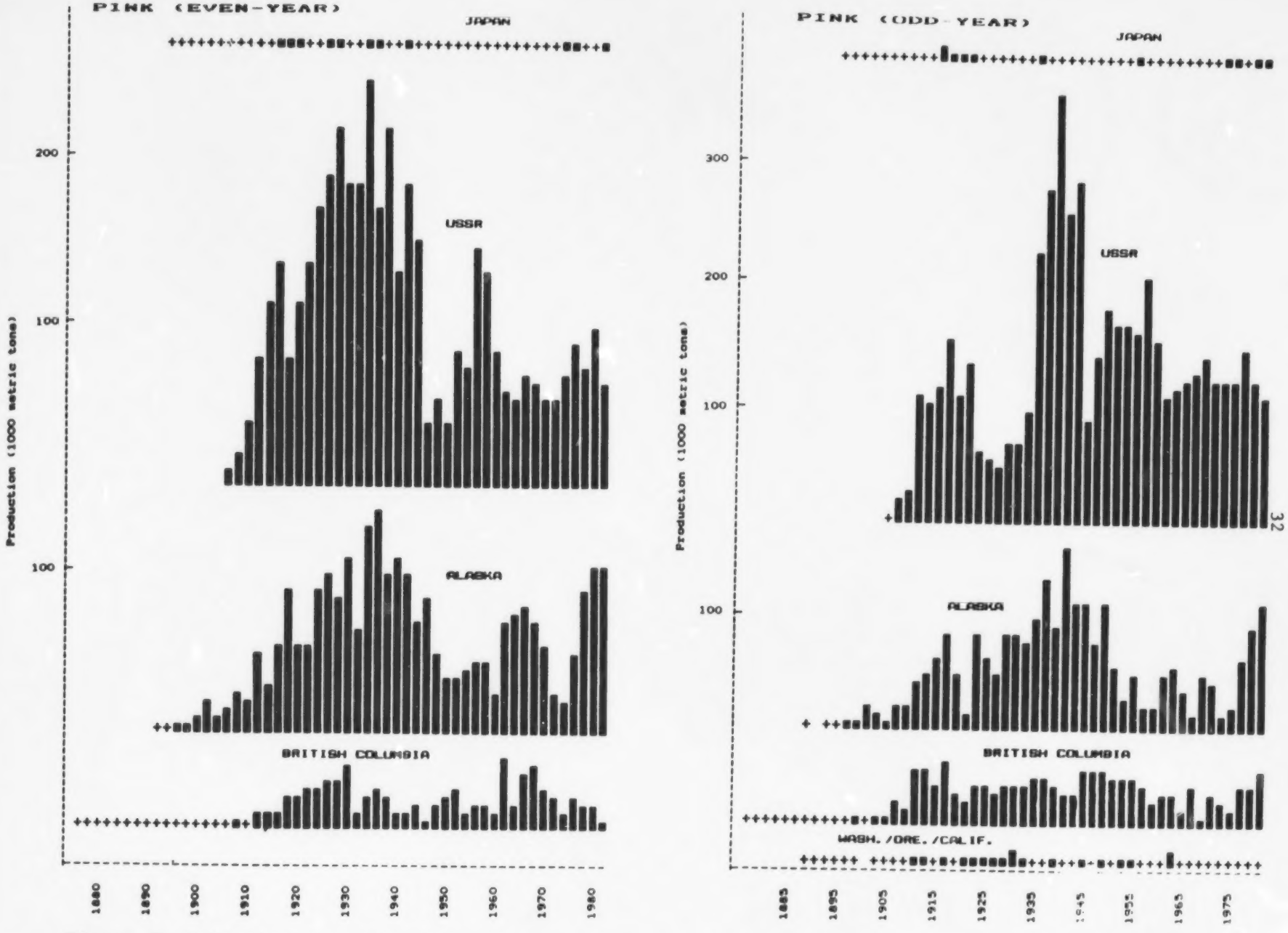

Figure 8. Estimated contributions of pink salmon originating in different areas, to commercial fisheries of the North Pacific.

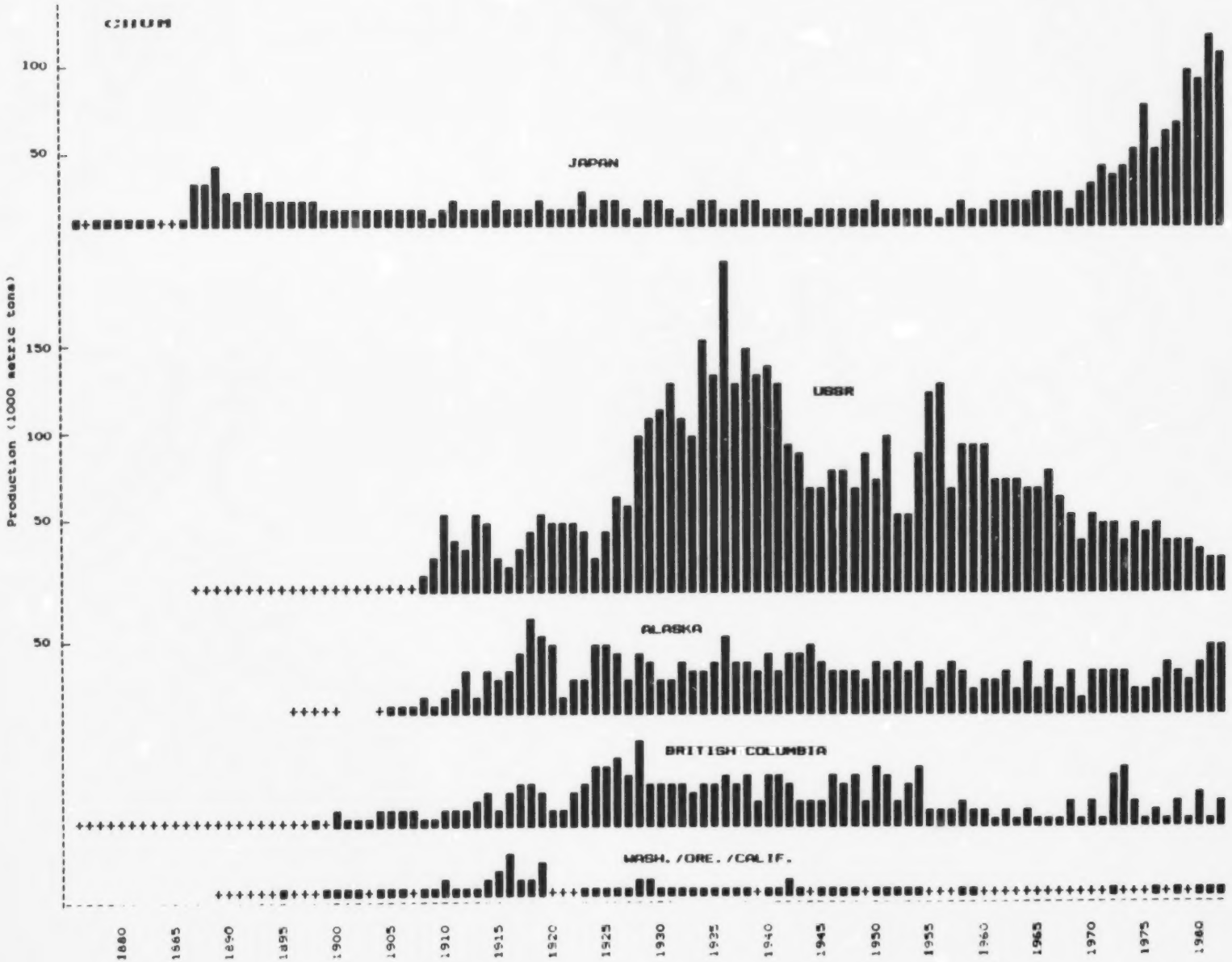

Figure 9. Estimated contributions of chum salmon originating in different areas, to commercial in the rivers of different areas around the North Pacific.

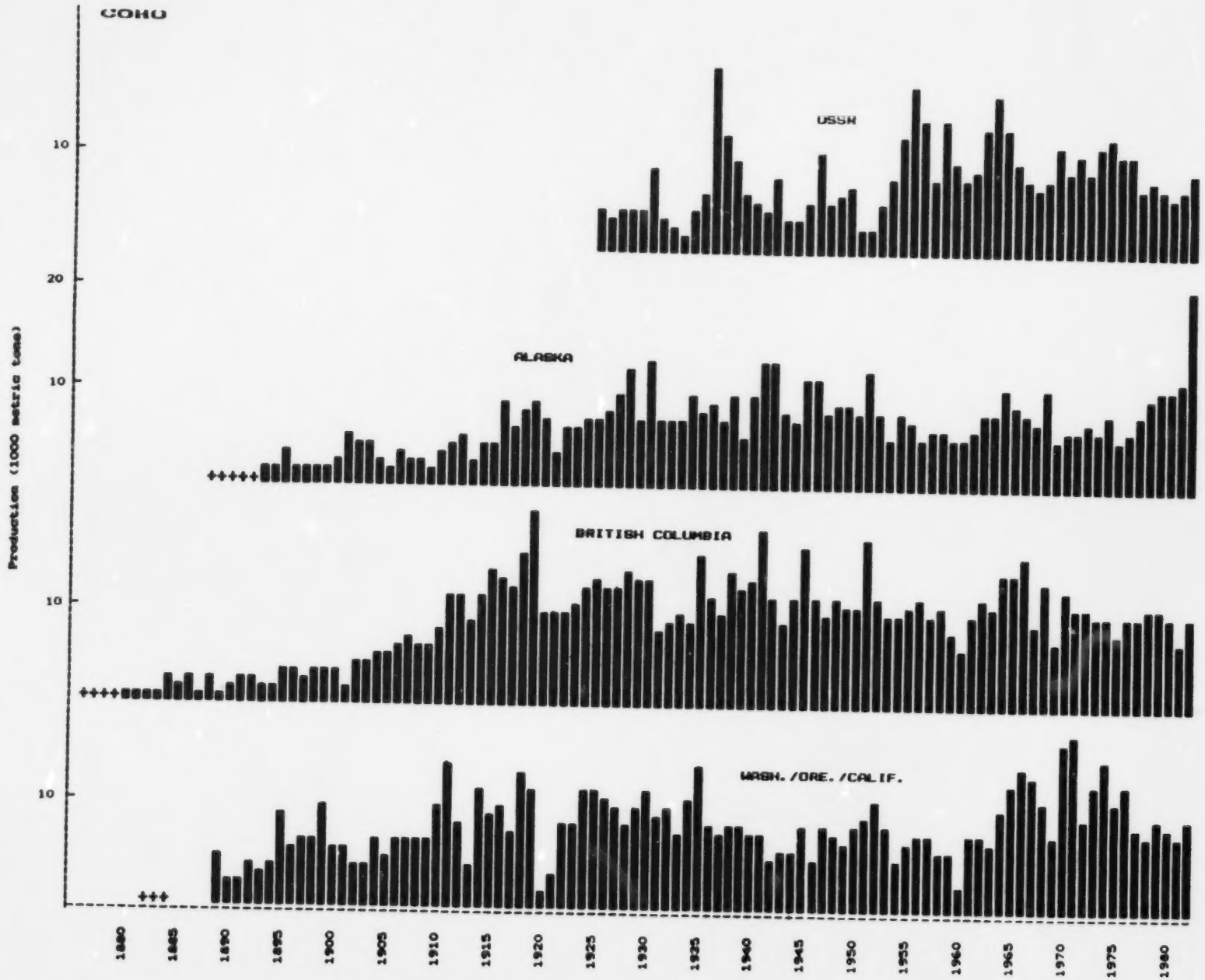

Figure 10. Estimated contributions of coho salmon originating in different areas, to commercial in the rivers of different areas around the North Pacific.

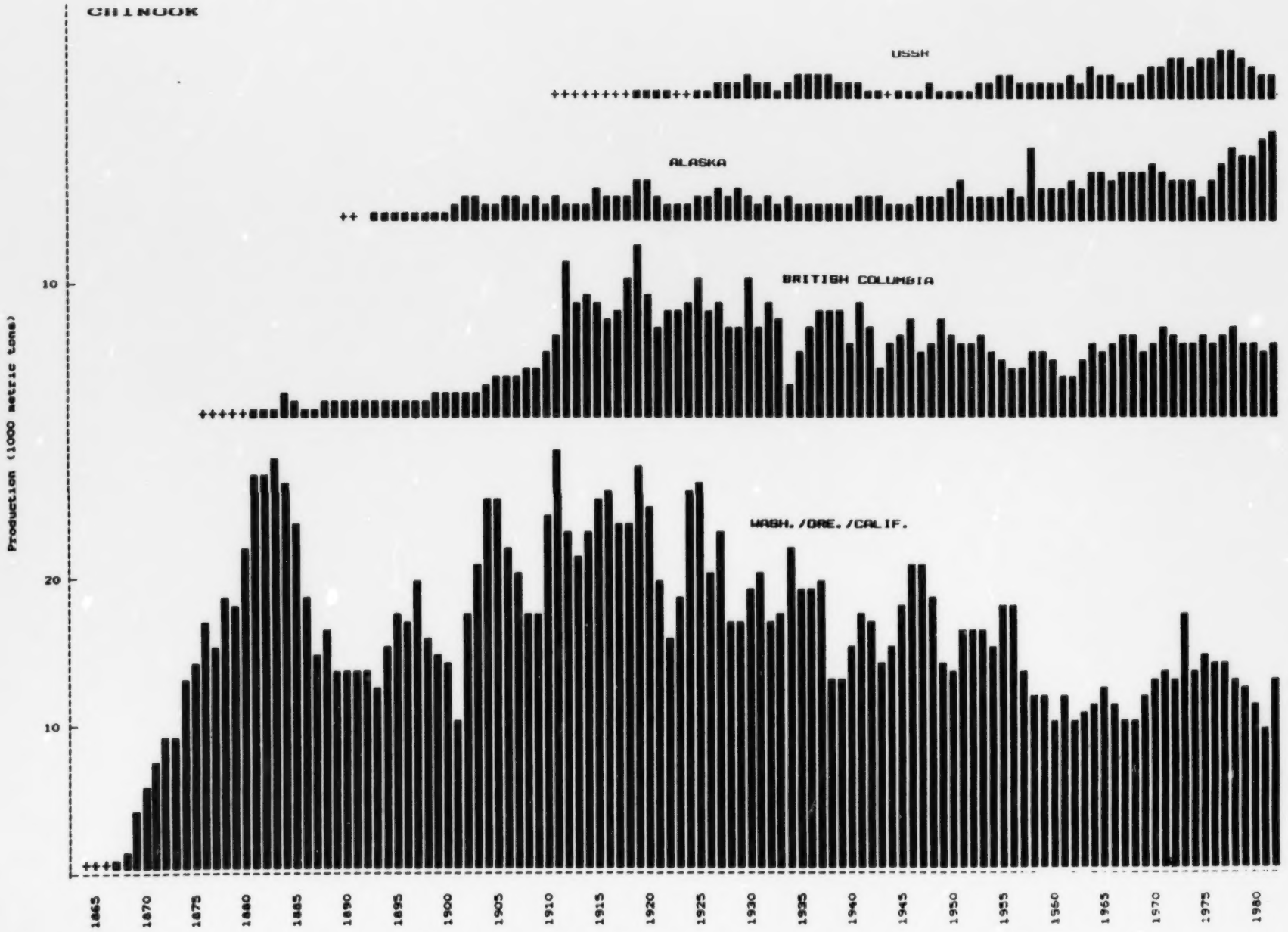

Figure 11. Estimated contributions of chinook salmon originating in different areas, to commercial in the rivers of different areas around the North Pacific.

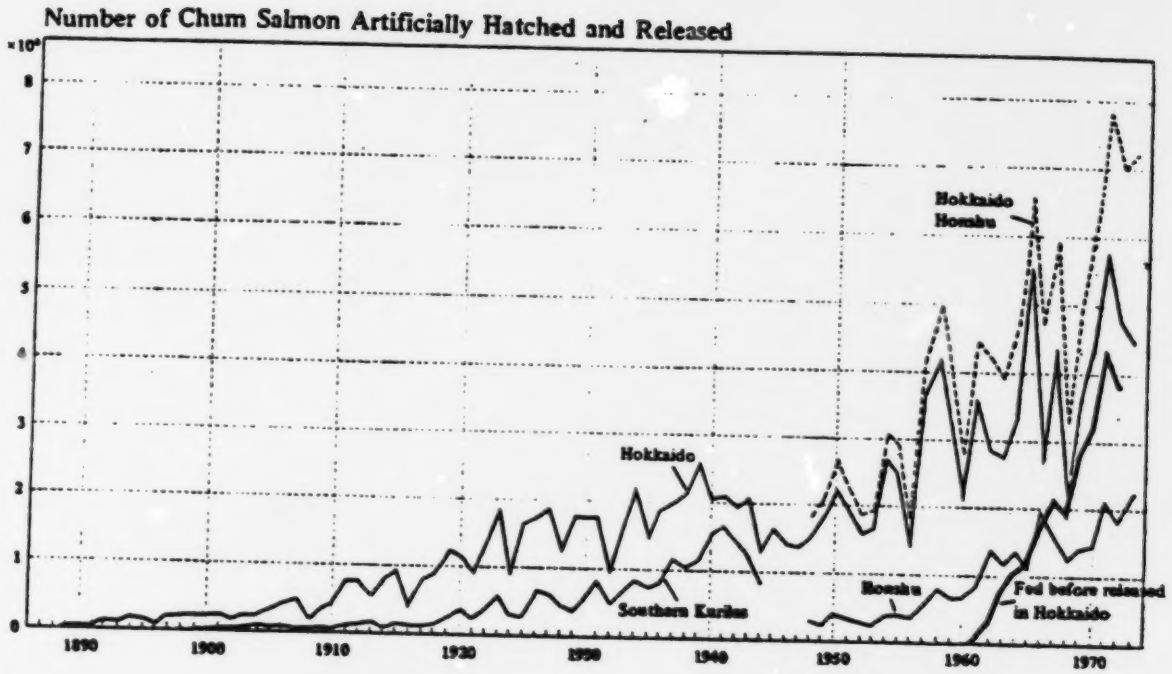

Figure 13. Numbers of juvenile chum salmon released from Japanese hatcheries, in hundreds of millions, 1889-1973. Source: Fish Farming in Japan. Japan Fisheries Association. 1975. 44 pp.

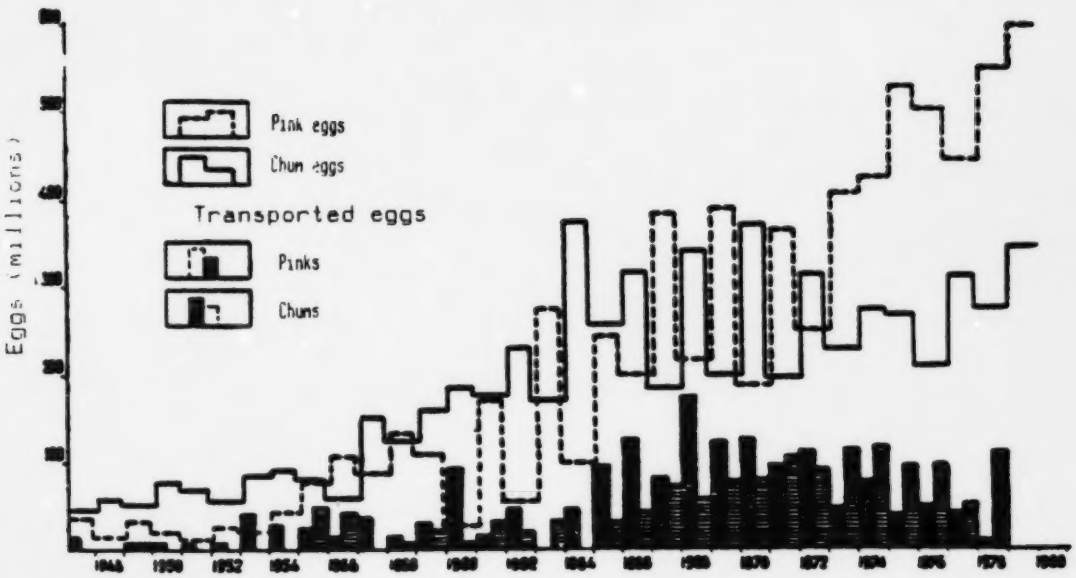

Figure 14. Numbers of pink and chum salmon eggs taken in Soviet hatcheries on Sakhalin Island, 1947-1980. Source: Ruklov (1982).

TABLES

Table 1. Production of Pacific salmon by geographic area during decades of peak production, and during 1973-1982.

	I	II	III	IV	V	VI	VII
		Peak Decade			1973-1982		
Area	Decade	Area Production (Tonnes)	Global Production (Tonnes)	Percent of Global Production	Area Production (Tonnes)	Percent of Global Production	Percent of Peak Decade Production
SOCKEYE							
Total	1928-1937	123,223			81,448		
NW U.S	1903-1912	475	102,566	0.5	153	0.2	32.1
Canada	1903-1912	38,634	102,566	37.7	18,975	23.3	49.0
Alaska	1911-1920	74,098	111,052	66.2	56,066	68.8	75.7
USSR	1928-1937	38,263	122,710	31.2	6,256	7.7	16.3
PINK (EVEN-YEAR)							
Total	1928-1936	324,236			159,027		
Canada	1962-1970	30,330	156,082	19.4	12,023	7.6	39.6
Alaska	1934-1942	109,336	314,348	34.8	69,811	43.9	63.9
USSR	1926-1934	200,097	320,327	62.5	74,921	47.1	37.4
Japan	1916-1924	2,083	211,752	1.0	2,272	1.4	58.5
PINK (ODD-YEAR)							
Total	1935-1943	420,215			208,966		
NW U.S.	1925-1933	7,319	170,803	4.3	1,781	0.9	24.3
Canada	1945-1953	42,780	263,340	16.2	29,328	13.6	66.2
Alaska	1937-1945	111,727	396,565	28.2	56,886	27.2	50.9
USSR	1935-1943	272,986	420,215	65.0	118,179	56.6	43.3
Japan	1915-1923	7,590	205,520	3.7	3,792	1.8	50.0
CHUM							
Total	1932-1941	202,412			144,269		
NW U.S.	1910-1919	11,477	100,683	11.4	2,691	1.9	23.5
Canada	1923-1932	30,586	149,664	20.4	13,806	9.6	45.1
Alaska	1917-1926	34,226	116,893	29.5	26,000	18.0	76.0
USSR	1931-1940	129,780	201,633	64.4	30,525	21.2	23.5
Japan	1973-1982	71,247	144,269	49.4	71,247	49.4	100.0
COHO							
Total	1962-1971	40,606			36,579		
NW U.S.	1965-1974	12,987	39,928	32.5	9,958	27.2	76.7
Canada	1937-1946	12,551	34,970	35.9	9,269	25.3	73.9
Alaska	1940-1949	9,477	34,065	27.8	9,135	25.0	96.4
USSR	1955-1964	11,532	34,545	33.4	8,216	22.5	71.3
CHINOOK							
Total	1911-1920	39,245			29,306		
NW U.S.	1911-1920	24,465	39,245	62.3	13,216	45.1	54.0
Canada	1915-1924	13,035	37,919	34.4	9,580	32.7	73.5
Alaska	1973-1982	3,935	29,306	13.4	3,935	13.4	100.0
USSR	1971-1980	2,703	29,712	9.1	2,574	8.8	95.2

Source: Shepard et al. 1985.

Table 2. Partitioning of Japanese chum salmon catches according to country of origin, in thousands of fish, 1930-1982.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
				Japan Bound						USSR Bound					Alaska Bound		Yukon Bound
Year	Hokkaido	Honshu	Total Japan Islands	Mother-ship	Land-based Longline	Land-based Driftnet	Total	USSR Coast	Japan Coast	Mother-ship	Land-based Longline	Land-based Driftnet	Total	Mother-ship	Land-based Driftnet	Total	Mother-ship
1930	3,349	927	4,276				4,276	16,021	154				16,175				
1931	2,806	1,116	3,922				3,922	10,996	125				11,121				
1932	1,570	763	2,333				2,333	12,194	112				12,306				
1933	1,895	591	2,485				2,485	14,183	187				14,370				
1934	3,999	1,041	5,040				5,040	22,693	511				23,204				
1935	4,206	1,204	5,410				5,410	20,589	753				21,342				
1936	2,640	968	3,607				3,607	40,327	536				40,863				
1937	2,696	802	3,498				3,498	28,373	634				29,007				
1938	4,153	632	4,786				4,786	31,258	1,243				32,500				
1939	3,604	669	4,273				4,273	24,603	1,143				25,746				
1940	2,666	522	3,188				3,188	25,077	944				26,021				
1941	2,137	638	2,776				2,776	22,132	792				22,923				
1942	2,096	550	2,646				2,646	17,654	552				18,206				
1943	1,923	708	2,631				2,631	6,973	269				7,242				
1944	1,846	254	2,100				2,100	2,466	(64)				2,402				
1945	2,484	446	2,930				2,930	244	294				538				
1946	1,781	755	2,536				2,536		309				309				
1947	2,365	371	2,736				2,736		48				48				
1948	2,969	305	3,274				3,274		15				15				
1949	3,394	122	3,516				3,516		429				429				
1950	4,657	203	4,860				4,860		1,090				1,090				
1951	3,099	134	3,233				3,233		3,167				3,167				
1952			2,614	10	<0.5	12	2,636			616	8	680	1,303				
1953			2,534	45	<0.5	25	2,604			2,662	2	1,466	4,130				
1954			3,815	157	-	45	4,017			9,247	-	2,641	11,888				
1955			2,711	310	<0.5	67	3,088	3,405		18,263	28	3,922	25,618				
1956			2,022	287	3	35	2,346	3,224		16,734	149	2,080	22,187	127		127	19
1957			3,597	154	14	64	3,829	2,662		9,052	810	3,744	16,268	35		35	5
1958			3,823	287	22	153	4,285	1,622		16,878	1,315	9,002	28,817	0		0	0
1959			2,334	215	25	151	2,725			12,622	1,455	8,894	22,972	19		19	3
1960			2,273	199	28	164	2,664			10,144	1,446	8,520	20,109	151		151	23
1961			3,850	132	28	131	4,141			5,935	1,288	5,973	13,197	53		53	8
1962			4,181	155	35	185	4,556			6,182	1,401	7,392	14,976	30		30	5
1963			4,902	162	50	208	5,322			5,643	1,760	7,329	14,733	46		46	7
1964			5,260	271	54	280	5,866			8,240	1,684	8,676	18,601	113		113	17
1965			6,625	214	42	296	7,177			5,731	1,146	8,034	14,910	79		79	12
1966			5,552	345	76	477	6,450			8,110	1,804	11,371	21,286	93		93	14
1967			6,393	312	56	506	7,267			6,443	1,163	10,572	18,178	71		71	11
1968			3,383	420	37	438	4,278			7,535	680	7,934	16,149	132	85	217	20
1969			5,674	453	17	288	6,433			7,096	278	4,571	11,944	150	49	199	22
1970			7,154	642	63	439	8,298			8,706	880	6,021	15,607	252	126	378	38
1971			10,130	753	40	472	11,395			8,964	491	5,657	15,112	218	121	339	33
1972			8,621	1,145		769	10,535			11,892		8,052	19,944	292	160	452	44
1973			11,475	763		761	12,999			6,965		6,936	13,901	112	140	252	17
1974			13,018	1,022		1,380	15,420			8,055		10,948	19,003	179	203	382	27
1975			20,066	920		1,483	22,469			6,321		10,195	16,516	110	199	309	16
1976			12,418	1,479		1,690	15,587			8,749		10,045	18,794	188	195	383	28
1977			15,237	963		1,001	17,201			4,733		5,125	9,858	261	105	366	39
1978			18,215	692		635	19,542			3,102		2,793	5,895	7	60	67	1
1979			27,983	677		591	29,251			2,557		2,224	4,781	37	46	83	6
1980			25,781	726		743	27,250			2,333		2,384	4,717	34	46	80	5
1981			33,604	674		822	35,100			1,837		2,219	4,056	24	53	77	4
1982			30,023	969		1,060	32,052			2,210		2,459	4,669	33	?	?	5

Source: Shepard et al. 1985.

Table 3. Numbers of chum salmon fry released from Japanese hatcheries, in thousands of fish, 1950-1983

	I	II	III	IV	V
		Hokkaido			
Year	Total	No. fed	% fed	Honshu Total	Japan Total
1950	222,422	NA	NA	NA	NA
1951	189,157	NA	NA	NA	NA
1952	159,557	NA	NA	NA	NA
1953	170,606	NA	NA	NA	NA
1954	269,338	NA	NA	NA	NA
1955	247,922	NA	NA	NA	NA
1956	140,454	NA	NA	NA	NA
1957	361,608	NA	NA	NA	NA
1958	417,238	NA	NA	NA	NA
1959	313,549	NA	NA	NA	NA
1960	203,413	NA	NA	NA	NA
1961	359,489	NA	NA	NA	NA
1962	280,743	NA	NA	NA	NA
1963	272,106	NA	NA	NA	NA
1964	334,463	NA	NA	NA	NA
1965	549,278	121,279	22.08	109,836	659,114
1966	272,036	157,492	57.89	196,469	468,505
1967	434,729	211,161	48.57	161,238	595,967
1968	207,438	192,143	92.63	121,193	328,631
1969	361,571	276,159	76.38	139,536	501,107
1970	442,101	321,033	72.62	144,670	586,771
1971	575,986	435,615	75.63	212,464	788,450
1972	475,805	376,969	79.23	224,943	700,748
1973	445,510	344,178	77.25	271,223	716,733
1974	484,849	350,700	72.33	271,708	756,557
1975	801,991	554,034	69.08	343,988	1,145,979
1976	523,361	432,156	82.57	287,133	810,494
1977	692,601	603,352	87.11	412,625	1,105,226
1978	779,261	665,212	85.36	433,177	1,212,438
1979	873,489	808,948	92.61	589,905	1,463,394
1980	1,146,179	957,874	83.57	750,113	1,896,292
1981	1,079,893	976,016	90.38	738,055	1,817,948
1982	1,113,893	1,027,451	92.24	863,396	1,977,289
1983	1,140,000	1,037,000	90.9%	870,000	2,010,000

NA Data not available.

Source: Japan Fish. Agency unpub.

Table 9. Fry releases and resultant adult returns of chum salmon from Hokkaido hatcheries, 1950-1983.

	I	II	III	IV	V	VI	VII	VIII
	Fry Output	Adult Returns (1000 fish)						
Brood Year	1000 fish	Age 2	Age 3	Age 4	Age 5	Age 6	Total	Percentage Return
1950	222,422	38	765	2,060	259	7	3,129	1.41
1951	189,157	27	1,039	1,454	241	14	2,770	1.46
1952	159,557	37	668	934	201	2	1,842	1.15
1953	170,606	32	659	1,136	162	1	1,990	1.17
1954	269,338	46	1,233	1,901	134	0	3,314	1.23
1955	247,922	34	851	1,044	77	2	2,008	0.81
1956	140,454	45	572	992	286	12	1,907	1.36
1957	361,608	31	628	1,830	555	16	3,060	0.85
1958	417,238	23	765	1,279	165	0	2,232	0.53
1959	313,549	59	896	1,829	382	0	3,166	1.01
1960	203,413	19	1,583	1,569	193	0	3,364	1.65
1961	359,489	147	1,817	3,429	544	0	5,937	1.65
1962	280,743	14	1,064	1,547	400	0	3,025	1.08
1963	272,106	44	1,701	3,018	220	0	4,983	1.83
1964	334,463	105	1,032	877	105	0	2,119	0.63
1965	549,278	17	808	1,615	132	0	2,572	0.47
1966	272,036	191	2,346	3,155	251	0	5,943	2.18
1967	434,729	79	1,876	5,342	813	0	8,110	1.87
1968	207,438	67	1,829	2,660	325	0	4,881	2.35
1969	361,571	180	3,324	4,589	644	0	8,737	2.42
1970	442,101	69	3,153	6,097	791	0	10,110	2.29
1971	575,986	102	2,640	9,350	821	0	12,913	2.24
1972	475,805	97	5,411	5,461	940	0	11,909	2.50
1973	445,510	23	2,311	5,754	948	0	9,036	2.03
1974	484,849	63	3,177	6,684	1,418	0	11,342	2.34
1975	801,991	36	5,203	13,132	2,951	0	21,322	2.66
1976	523,361	62	3,813	7,276	1,936	0	13,088	2.50
1977	692,601	60	4,716	13,681	2,654		21,110	3.05
1978	779,261	191	5,827	12,904			18,922	(2.43)*
1979	873,489	52	3,928				3,980	(0.46)*
1980	1,146,179	273						
1981	1,079,893							
1982	1,113,893							
1983	1,140,000							

* Incomplete returns.

Source: Fish. Agency Japan Unpub. data.

Table 5. Numbers of juvenile chum salmon released from Japanese hatcheries and approximate resultant adult returns for th 1950-1978 brood years

	I	II	III	IV	V	VI	VII	VIII	IX
	Juvenile Releases			Adult Returns					
Year	Hokkaido	Honshu	Total	Hokkaido Percentage Return	All Japan Coastal Catch	Coastal Percentage Return	High Seas Catch	Total Catch	Total Percentage Return
1950	222,422	40,000	262,422	1.41	3815	1.45	202	4,017	1.53
1951	189,157	36,000	225,157	1.46	2711	1.20	377	3,088	1.37
1952	159,557	30,000	189,557	1.15	2022	1.07	324	2,346	1.24
1953	170,606	27,000	197,606	1.17	3597	1.82	232	3,829	1.94
1954	269,338	35,000	304,338	1.23	3823	1.26	462	4,285	1.41
1955	247,922	40,000	287,922	0.81	2334	0.81	391	2,725	0.95
1956	140,454	35,000	175,454	1.36	2273	1.30	391	2,664	1.52
1957	361,608	50,000	411,608	0.85	3850	0.94	291	4,141	1.01
1958	417,238	80,000	497,238	0.53	4181	0.84	375	4,556	0.92
1959	313,549	68,000	381,549	1.01	4902	1.28	420	5,322	1.39
1960	203,413	65,000	268,413	1.65	5260	1.96	606	5,866	2.19
1961	359,489	80,000	439,489	1.85	6625	1.51	552	7,177	1.63
1962	280,743	140,000	420,743	1.08	5552	1.32	898	6,450	1.53
1963	272,106	120,000	392,106	1.83	6393	1.63	874	7,267	1.85
1964	334,463	135,000	469,463	0.63	3383	0.72	895	4,278	0.91
1965	549,278	109,836	659,114	0.47	5674	0.86	759	6,433	0.98
1966	272,036	196,469	468,505	2.18	7154	1.53	1,144	8,298	1.77
1967	434,729	161,238	595,967	1.87	10830	1.70	1,265	11,395	1.91
1968	207,438	121,193	328,631	2.35	8621	2.62	1,914	10,535	3.21
1969	361,571	139,536	501,107	2.42	11475	2.29	1,524	12,999	2.59
1970	442,101	144,670	586,771	2.29	13018	2.22	2,402	15,420	2.63
1971	575,986	212,464	788,450	2.24	20066	2.54	2,403	22,469	2.85
1972	475,805	224,943	700,748	2.50	12418	1.77	3,169	15,587	2.22
1973	445,510	271,223	716,733	2.03	15237	2.13	1,964	17,201	2.40
1974	484,849	271,708	756,557	2.34	18215	2.41	1,327	19,542	2.58
1975	801,991	343,988	1,145,979	2.66	27983	2.44	1,268	29,251	2.55
1976	523,361	287,133	810,494	2.50	25781	3.16	1,469	27,250	3.36
1977	692,601	412,625	1,105,226	3.05	33604	3.04	1,496	35,100	3.18
1978	779,261	433,177	1,212,438		30023	2.48	2,029	32,052	2.64
1979	873,489	589,905	1,463,394		33,300 *	2.28			
1980	1,146,179	750,113	1,896,292		46,455 **	2.45 **			
1981	1,079,893	738,055	1,817,948		44,536 **	2.45 **			
1982	1,113,893	863,396	1,977,289		48,417 **	2.45 **			
1983	1,140,000	870,000	2,010,000		49,218 **	2.45 **			

Average, 1976-1979: 1,147,888 Average, 1968-1979: 2.45
Average, 1980-1983: 1,925,382

* Preliminary data ** Projected values - See Text

Sources: Japan Fish. Agency unpub. & Shepard et al. 1985.

Table 6. Aggregate catches of pink salmon by USSR and Japanese fisheries in inshore fishing areas now lying within the jurisdiction of the USSR, in numbers of fish, 1906-1982.

	SAKHALIN/KURILES		KAMCHATKA		OTHER		TOTAL**	
YEAR	EVEN	ODD	EVEN	ODD	EVEN	ODD	EVEN	ODD
1906 *	7,622,875						7,622,875	
1907 *		15,505,410						15,505,410
1908 *	7,068,066		6,796,000		472,000		14,336,066	
1909 *		5,219,036		13,505,000		789,000		19,513,036
1910 *	13,083,289		6,511,000		497,000		20,091,289	
1911 *		8,887,879		49,599,000		1,343,000		59,829,879
1912 *	20,505,677		20,015,000		273,000		40,793,677	
1913 *		11,145,825		32,205,000		579,000		43,929,825
1914 *	8,087,230		58,250,000		1,152,000		67,489,230	
1915 *		6,208,655		60,154,000		545,000		66,907,655
1916 *	10,836,842		73,595,000		3,045,000		87,476,842	
1917 *		33,693,130		61,750,000		390,000		95,833,130
1918 *	5,171,311		40,937,000		1,553,000		47,661,311	
1919 *		19,038,485		41,053,000		233,000		61,124,485
1920 *	4,707,740		62,638,000		2,686,000		70,031,740	
1921 *		12,361,669		68,431,000		565,000		81,357,669
1922 *	6,742,658		76,288,000		1,993,000		85,023,658	
1923 *		2,340,031		28,887,000		335,000		31,562,031
1924 *	13,631,376		91,767,000		448,000		105,846,376	
1925 *		5,304,482		16,454,000		690,000		22,448,482
1926	24,141,422		79,775,770		12,751,004		116,668,196	
1927		700,927		22,235,054		3,919,837		26,855,819
1928	27,891,808		72,677,376		10,314,592		110,883,776	
1929		924,652		10,855,378		6,433,424		18,214,054
1930	14,139,876		16,412,316		65,066,934		95,619,127	
1931		805,873		36,218,071		6,383,832		43,407,775
1932	6,636,785		82,886,212		10,949,130		100,472,127	
1933		1,167,002		25,057,065		15,987,092		42,211,159
1934	9,468,315		72,262,383		11,311,914		93,042,612	
1935 *		26,201,700		80,449,000		10,249,000		116,899,700
1936 *	3,334,621		53,908,000		19,118,000		76,360,621	
1937 *		12,005,410		56,935,000		2,836,000		71,776,410
1938 *	6,510,819		42,418,000		1,767,000		50,695,819	
1939 *		18,857,032		63,163,000		1,133,000		83,153,032

Continued ...

Table 6. Continued

	SAKHALIN/KURILES		KAMCHATKA		OTHER		TOTAL**	
YEAR	EVEN	ODD	EVEN	ODD	EVEN	ODD	EVEN	ODD
1940	4,894,900		55,596,286		7,510,768		68,001,954	
1941		16,595,054		91,161,478		12,432,478		120,189,011
1942	2,014,683		75,711,904		9,300,866		87,027,453	
1943		8,502,318		110,924,217		18,384,674		137,811,210
1944	695,518		74,884,784		13,052,209		88,632,511	
1945		1,081,917		41,236,413		9,578,804		51,897,134
1946	3,091,190		18,139,224		4,819,277		26,049,691	
1947		23,415,765		58,695,652		10,665,761		92,777,178
1948	4,327,666		21,352,075		9,839,357		35,519,099	
1949		36,553,323		68,750,000		11,209,239		116,512,562
1950	4,404,946		18,808,568		1,740,295		24,953,808	
1951		25,888,717		70,040,761		12,364,130		108,293,608
1952	6,568,779		30,990,629		2,074,967		39,634,375	
1953		4,327,666		78,804,348		14,062,500		97,194,514
1954	12,982,998		18,005,355		1,673,360		32,661,713	
1955		11,360,124		36,616,848		13,383,152		61,360,124
1956	27,588,872		18,674,699		5,689,424		51,952,995	
1957		9,428,130		51,222,826		12,771,739		73,422,695
1958	14,837,713		2,008,032		10,843,373		27,689,118	
1959		11,416,538		18,264,946		3,710,598		33,392,081
1960	3,637,558		4,417,671		5,576,975		13,632,203	
1961		5,548,686		12,299,402		3,396,739		21,234,828
1962	1,175,000		5,909,000		3,696,000		10,780,000	
1963		3,594,000		13,290,000		7,687,000		24,571,000
1964	1,800,000		5,809,000		3,018,000		10,627,000	
1965		13,281,000		13,941,000		7,452,000		34,674,000
1966	6,565,000		4,838,000		2,609,000		14,012,000	
1967		16,499,000		12,122,000		4,465,000		33,086,000
1968	6,965,000		1,814,000		1,305,000		10,084,000	
1969		27,221,000		10,961,000		4,591,000		42,773,000
1970	6,448,000		4,238,000		430,000		11,116,000	
1971		26,200,000		9,519,000		3,066,000		38,785,000
1972	11,402,000		1,560,000		617,000		13,579,000	
1973		39,811,000		6,842,000		3,214,000		49,867,000
1974	17,865,000		4,557,000		888,000		23,310,000	
1975		41,837,000		10,356,000		3,943,000		56,136,000
1976	NA		NA		NA		NA	
1977		NA		NA		NA		NA
1978	27,612,000		11,997,500		5,660,700		45,270,200	
1979		21,259,800		60,038,000		5,248,600		86,545,400
1980	NA		NA		NA		NA	
1981		NA		NA		NA		NA
1982	NA		NA		NA		NA	

NA: Data not available. * Data available only for Japan. ** Sum of catches for which area breakdowns available

Sources: INPFC Bull. 39, INPFC Stat. Yearbooks for 1978-1979, and FAO Yearbooks of Fish Stats. for 1976, 1977 and 1980-1982.

Table 7. Percentage distribution of catches of pink salmon around the USSR coast, 1906-1982

	SAKHALIN/KURILES		KAMCHATKA		OTHER	
YEAR	EVEN	ODD	EVEN	ODD	EVEN	ODD
1906 *	100.00		0.00		0.00	
1907 *		100.00		0.00		0.00
1908 *	49.30		47.40		3.29	
1909 *		26.75		69.21		4.04
1910 *	65.12		32.41		2.47	
1911 *		14.86		82.90		2.24
1912 *	50.27		49.06		0.67	
1913 *		25.37		73.31		1.32
1914 *	11.98		86.31		1.71	
1915 *		9.28		89.91		0.81
1916 *	12.39		84.13		3.48	
1917 *		35.16		64.43		0.41
1918 *	10.85		85.89		3.26	
1919 *		32.46		67.16		0.38
1920 *	6.72		89.44		3.84	
1921 *		15.19		84.11		0.69
1922 *	7.93		89.73		2.34	
1923 *		7.41		91.52		1.06
1924 *	12.88		86.70		0.42	
1925 *		23.63		73.30		3.07
1926	20.69		68.38		10.93	
1927		2.61		82.79		14.60
1928	25.15		65.54		9.30	
1929		5.08		59.60		35.32
1930	14.79		17.16		68.05	
1931		1.86		83.44		14.71
1932	6.61		82.50		10.90	
1933		2.76		59.36		37.87
1934	10.18		77.67		12.16	
1935 *		22.41		68.82		8.77
1936 *	4.37		70.60		25.04	
1937 *		16.73		79.32		3.95
1938 *	12.84		83.67		3.49	
1939 *		22.68		75.96		1.36

Continued ...

Table 7. Continued

YEAR	SAKHALIN/KURILES		KAMCHATKA		OTHER	
	EVEN	ODD	EVEN	ODD	EVEN	ODD
1940	7.20		81.76		11.04	
1941		13.81		75.85		10.34
1942	2.31		87.00		10.69	
1943		6.17		80.49		13.34
1944	0.78		84.49		14.73	
1945		2.08		79.46		18.46
1946	11.87		69.63		18.50	
1947		25.24		63.27		11.50
1948	12.18		60.11		27.70	
1949		31.37		59.01		9.62
1950	17.65		75.37		6.97	
1951		23.91		64.68		11.42
1952	16.57		78.19		5.24	
1953		4.45		81.08		14.47
1954	39.75		55.13		5.12	
1955		18.51		59.68		21.81
1956	53.10		35.95		10.95	
1957		12.84		69.76		17.39
1958	53.59		7.25		39.16	
1959		34.19		54.70		11.11
1960	26.68		32.41		40.91	
1961		26.13		57.87		16.00
1962	10.90		54.81		34.29	
1963		14.63		54.09		31.28
1964	16.94		54.66		28.40	
1965		38.30		40.21		21.49
1966	46.85		34.53		18.62	
1967		49.87		36.64		13.50
1968	69.07		17.99		12.94	
1969		63.64		25.63		10.73
1970	58.01		38.13		3.87	
1971		67.55		24.54		7.91
1972	83.97		11.49		4.54	
1973		79.83		13.72		6.45
1974	76.64		19.55		3.81	
1975		74.53		18.45		7.02
1976	NA		NA		NA	
1977		NA		NA		NA
1978	60.99		26.50		12.50	
1979		24.56		69.37		6.06
1980	NA		NA		NA	
1981		NA		NA		NA
1982	NA		NA		NA	

NA: Data not available. * Data available only for Japan. Note: percentages calculated on the basis of catches for which area breakdowns were available. available.

Source: Table 6, See Text.

Table 9. Biennial total catches of pink salmon, in thousands of fish, along the coast of the USSR, 1906-1982.

YEARS	SAKHALIN, KURILES	KAMCHATKA	OTHER	TOTAL*
1906 - 1907 *	23,128,285	NA	NA	23,128,285
1908 - 1909 *	12,287,102	20,301,000	1,261,000	33,849,102
1910 - 1911 *	21,971,168	56,110,000	1,840,000	79,921,168
1912 - 1913 *	31,651,502	52,220,000	852,000	84,723,502
1914 - 1915 *	14,295,886	118,404,000	1,697,000	134,396,886
1916 - 1917 *	44,529,972	135,345,000	3,435,000	183,309,972
1918 - 1919 *	25,009,796	81,990,000	1,786,000	108,785,796
1920 - 1921 *	17,069,410	131,069,000	3,251,000	151,389,410
1922 - 1923 *	9,082,689	105,175,000	2,328,000	116,585,689
1924 - 1925 *	18,935,858	108,221,000	1,138,000	128,294,858
1926 - 1927	24,842,349	102,010,824	16,670,841	143,524,014
1928 - 1929	28,816,461	83,533,354	16,748,016	129,097,831
1930 - 1931	14,945,750	52,630,387	71,450,766	139,026,902
1932 - 1933	7,803,787	107,943,277	26,936,222	142,683,286
1934 - 1935 *	35,670,015	152,711,383	21,560,914	209,942,313
1936 - 1937 *	15,340,031	110,843,000	21,954,000	148,137,031
1938 - 1939 *	25,367,852	105,581,000	2,900,000	133,848,852
1940 - 1941	21,489,954	146,757,765	19,943,247	188,190,965
1942 - 1943	10,517,002	186,636,121	27,685,540	224,838,663
1944 - 1945	1,777,434	116,121,198	22,631,013	140,529,645
1946 - 1947	26,506,955	76,834,876	15,485,038	118,826,869
1948 - 1949	40,880,989	90,102,075	21,048,597	152,031,661
1950 - 1951	30,293,663	88,849,328	14,104,425	133,247,416
1952 - 1953	10,896,445	109,794,977	16,137,467	136,828,889
1954 - 1955	24,343,122	54,622,203	15,056,512	94,021,837
1956 - 1957	37,017,002	69,897,525	18,461,163	125,375,690
1958 - 1959	26,254,250	20,272,978	14,553,971	61,081,199
1960 - 1961	9,186,244	16,707,073	8,973,714	34,867,031
1962 - 1963	4,769,000	19,199,000	11,383,000	35,351,000
1964 - 1965	15,081,000	19,750,000	10,470,000	45,301,000
1966 - 1967	23,064,000	16,960,000	7,074,000	47,098,000
1968 - 1969	34,186,000	12,775,000	5,896,000	52,857,000
1970 - 1971	32,648,000	13,757,000	3,496,000	49,901,000
1972 - 1973	51,213,000	8,402,000	3,831,000	63,446,000
1974 - 1975	59,702,000	14,913,000	4,831,000	79,446,000
1976 - 1977	NA	NA	NA	107,928,000
1978 - 1979	48,870,800	72,035,500	10,909,300	131,815,600
1980 - 1981	NA	NA	NA	105,207,000
1982	NA	NA	NA	28,218,000

NA: Data not available. * Data on catches by area available only for Japan. ** Sum of catches for which area breakdowns are available.

Note: Total combined Japanese and USSR catch (including USSR catches for which area of capture data not available) in 1934/35, 1936/37, and 1938/39 were 260,984,132, 203,310,230 and 233,984,852.

Sources: Table 6, INPFC Bull. 39, INPFC Stat. Yearbooks for 1978-1979, and FAO Yearbooks of Fish. Stats. for 1976, 1977 and 1980-1982.

Table 9. Global landings of Atlantic salmon, in metric tonnes, 1960-1982.

Year	Finland	France	England-Wales	Scotland	Ireland	Northern Ireland	Norway	Sweden (West Coast)
1960		75	283	1,436	743	139	1,659	40
1961		75	232	1,196	707	132	1,533	27
1962		75	318	1,740	1,459	356	1,935	45
1963		75	325	1,698	1,458	306	1,786	23
1964		75	307	1,914	1,617	377	2,147	36
1965		75	320	1,563	1,457	281	2,000	40
1966		75	387	1,624	1,238	287	1,791	36
1967	21	75	420	2,133	1,463	449	1,960	25
1968	21	75	282	1,563	1,413	312	1,514	20
1969	19	75	377	1,947	1,730	267	1,383	22
1970	18	75	527	1,329	1,787	297	1,171	20
1971	18	75	426	1,419	1,639	234	1,207	18
1972	30	34	442	1,693	1,804	210	1,568	18
1973	46	12	450	1,964	1,930	182	1,726	23
1974	73	13	383	1,631	2,128	184	1,633	32
1975	72	25	447	1,561	2,216	164	1,537	26
1976	63	9	208	1,010	1,561	113	1,530	20
1977	56	19	345	1,131	1,372	110	1,488	10
1978	36	20	349	1,290	1,230	148	1,050	10
1979	25	10	261	1,225	1,097	99	1,831	12
1980	33	30	348	1,090	947	122	1,830	17
1981	43	28	493	1,188	685	101	1,655	26
1982	56	20	289	1,121	993	132	1,345	25

Year	USSR	Iceland	West Greenland	Northern Norwegian Sea	Faroese Long-Line Area	Canada	United States	Total
1960	1,100	100	60			1,636	2	7,273
1961	790	127	127			1,583	2	6,531
1962	710	125	244			1,719	2	8,728
1963	480	145	466			1,851	2	8,615
1964	590	135	1,539			2,069	2	10,808
1965	590	133	861 ?			2,116	2	9,438
1966	570	106	1,370 ?			2,359	2	9,845
1967	883	146	601	77		2,863	2	11,118
1968	827	162	1,127	403	5	2,111	2	9,837
1969	360	133	2,210	911	7	2,202	2	11,645
1970	448	195	2,146	946	12	2,323	2	11,296
1971	417	204	2,689	488	0	1,992	2	10,828
1972	462	250	2,113	506	9	1,759	2	10,900
1973	772	256	2,341	533	28	2,434	3	12,700
1974	709	225	1,917	373	20	2,539	1	11,861
1975	811	266	2,030	475	28	2,485	2	12,145
1976		225	1,175	289	40	2,506	1	8,750
1977		230	1,420	192	40	2,545	2	8,961
1978		291	984	124	51	1,545	4	7,132
1979	430	225	1,395	118	194	1,287	3	8,212
1980	631	249	1,194	155	718	2,680	6	10,050
1981	450	163	1,264	213	1,027	2,437	6	9,779
1982	311	147	1,077	334	939	1,798	6	8,594

Source: FAO Yearbooks of Fish. Stats.

Table 10. Production of Atlantic salmon in marine culture facilities in Norway and the United Kingdom, in metric tonnes, 1972-1983.

Year	Norway	United Kingdom	Total
1972	150		150
1973	200		200
1974	608	20	628
1975	862	100	962
1976	1430	200	1630
1977	2137	300	2437
1978	3550	400	3950
1979	4142	520	4662
1980	4153	598	4751
1981	8400	1133	9533
1982	10200	2150	12350
1983	17000 *	NA	17000 +

* Estimate

Source: Dept. Fish. Oceans, Ottawa.